Vol. 9, No. 14
July 31, 1984

Energy Research Abstracts

Abstracts 25181-27709

Technical Information Center
Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $6.00, foreign $7.50 per copy; annual cumulative index, domestic $10.00, foreign $12.50 per copy. The annual subscription price is $70.00 for domestic subscribers and $87.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign).

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription as PB84-946800 from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic subscribers and $28.00 for subscribers outside the North American continent; prices for single issues are $7.00 and $14.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers. A single issue is $7.00 (domestic) and $14.00 (foreign).

***Current Energy Patents (CEP)*–PB84-902800**

Provides coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB84-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB84-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB84-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB84-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

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***Acid Precipitation (APC)*–PB84-901000**

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***Coal-Based Synfuels (CBS)*–PB84-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB84-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB84-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Geothermal Energy Technology (GET)*–PB84-914700**

Devoted to information on the exploration, development, and utilization of geothermal resources.

***Laser Research (LAR)*–PB84-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB84-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

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Covers the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

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***Solar Thermal Energy Technology (STT)*–PB84-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB84-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information, Technical Information Center (TIC) cooperates with the following organizations in the publication of international abstract journals: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts;* and (3) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts.* In each case, the cognizant foreign agency provides the non-U.S. information to TIC for inclusion in the Energy Data Base; in turn, TIC provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Office of Scientific and Technical Information, Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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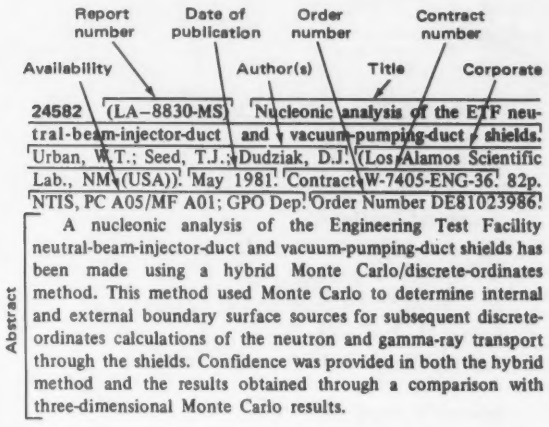
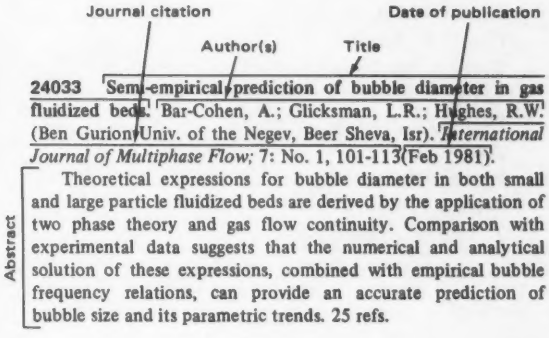
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Order number
Contract number
Availability
Author(s)
Title
Corporate
24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE81023986.
Abstract
A nucleonic analysis of the Engineering Test Facility neutral-beam-injector-duct and vacuum-pumping-duct shields has been made using a hybrid Monte Carlo/discrete-ordinates method. This method used Monte Carlo to determine internal and external boundary surface sources for subsequent discrete-ordinates calculations of the neutron and gamma-ray transport through the shields. Confidence was provided in both the hybrid method and the results obtained through a comparison with three-dimensional Monte Carlo results.


Journal citation
Date of publication
Author(s)
Title
24033 Semi-empirical prediction of bubble diameter in gas fluidized beds. Bar-Cohen, A.; Glicksman, L.R.; Hughes, R.W. (Ben Gurion Univ. of the Negev, Beer Sheva, Isr). International Journal of Multiphase Flow; 7: No. 1, 101-113 (Feb 1981).
Abstract
Theoretical expressions for bubble diameter in both small and large particle fluidized beds are derived by the application of two phase theory and gas flow continuity. Comparison with experimental data suggests that the numerical and analytical solution of these expressions, combined with empirical bubble frequency relations, can provide an accurate prediction of bubble size and its parametric trends. 25 refs.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

24582 (LA–8830-MS) Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields. Urban, W.T.; Seed, T.J.; Dudziak, D.J. **(Los Alamos Scientific Lab., NM (USA)).** May 1981. Contract W-7405-ENG-36. 82p. NTIS, PC A05/MF A01. Order Number DE81023986.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Bar-Cohen, A., Semi-empirical prediction of bubble diameter in gas fluidized beds, 7:24033 (J:US)
Dudziak, D.J., *See* Urban, W.T., 6:24582
Glicksman, L.R., *See* Bar-Cohen, A., 7:24033
Hughes, R.W., *See* Bar-Cohen, A., 7:24033
Seed, T.J., *See* Urban, W.T., 6:24582
Urban, W.T., Nucleonic analysis of the ETF neutral-beam-injector-duct, and vacuum-pumping-duct shields, 6:24582 (R:US)

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

TOKAMAK ETF
Neutral Atom Beam Injection
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)
Neutron Transport
Nucleonic analysis of the ETF neutral-beam-injector-duct and vacuum-pumping-duct shields, 6:24582 (R:US)

• Contract Number Index

DOE technical literature is indexed using contract numbers under which the literature was produced. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36 **Los Alamos National Lab., NM (USA)**
6:24582 **LA–8830-MS**

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order Number–Report Number Correlation is included for convenience.

LA–
8830-MS **6:24582** **NTIS, PC A05/MF A01; GPO Dep. Order Number DE81023986, Distribution Category STD-20d**

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 25258, 25259, 25274, 25282, 25323, 25323, 25607, 25615, 25631, 25785, 26312, 26408, 26408, 26514, 26524, 26529, 27009

25181 (ANL/FE—83-28) Analysis of an oxidant tube from the Westinghouse Coal Gasification PDU. Diercks, D.R. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011427.

An uncoated Incoloy 825 oxidant tube was removed from the Westinghouse Coal Gasification PDU after approximately 650 h of service. Except for the region within about 5 cm (2 in.) of the tip, the tube exhibited extensive attack and wastage at the outer surface. Metallographic and scanning electron microprobe examinations of a sample taken from the interface between the attacked and unattacked regions revealed extensive sulfidation of the base metal in the attacked areas, but the unattacked regions showed only a surface metal in the attacked areas, but the unattacked regions showed only a surface ash deposit. It was concluded that the tube failed owing to the combined effects of erosion and corrosion associated with contact with the gasifier fluidized bed. Suggested remedies for improving component life include replacing the Incoloy 825 base metal with Type 310 stainless steel, and the possible placement of a mullite ceramic sleeve over the tube to improve resistance to erosion. Repositioning the tube in the gasifier to reduce its exposure to erosive conditions should also be explored. However, even with these suggested remedies, the oxidant tube should be considered an expendable component requiring periodic replacement.

25182 (BMFT-FB-T—83-240) Investigations on the application of iron salt containing waste acids for the catalytic gasification of coals and cokes with H_2/H_2O. Huettinger, K.J.; Adler, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 134p. (In German). NTIS (US Sales Only), PC A07 MF/A01. Order Number DE84750930.

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The project was concerned with the catalytic gasification of coal and coke with hydrogen and water vapour using iron salts as catalyst raw materials. In order to overcome fundamental problems of iron catalysis studies with miscellaneous catalysts composed of iron and potassium were performed. The results of investigations are summarized as follows: 1) Limitation of the catalytic gasification resulting from the nature of catalyst. 2) Limitations of catalytic gasification resulting from composition and structure of the carbonaceous raw materials. 3) Extention of the field of application of catalytic gasification. Iron has been confirmed as to be an efficient catalyst of hydrogasification. The starting temperature is in the range of 800°C, pressure up to 1 MPa increases the gasification rate. Iron also is an excellent catalyst for water vapour gasification as far as pressure is low and the coal or coke do not exhibit any sulfur. In this case starting temperature of catalysis is around 750°C. Iron catalysis is strongly inhibited by increasing pressure. Sulfur represents a strong poison for iron and potassium catalyzed gasification under reducing conditions. Best results and acceptable solutions were achieved by using a miscellaneous catalyst consisting of 2 parts iron and 5 parts potassium. This catalyst exhibits a low starting temperature and a strong catalytic effect even under increased pressure including oxidizing or reducing conditions.

25183 (CONF-840652—2) Transient simulation and experimental verification of gas-steam and liquid-steam, shell and tube type heat exchangers. Daniel, K.J.; Crapo, A.W.; Brown, D.H. (General Electric Co., Schenectady, NY (USA). Research and Development Center). 1984. Contract AC21-80ET14928. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005705.

From American Control conference; San Diego, CA, USA (6 Jun 1984).

In order to develop advanced control systems for complex chemical processes, the engineer must be able to reliably predict the transient response of all of the components in the system. This paper reports on part of an on-going project to develop an experimentally verified engineering tool for developing controls of a coal gasification fuel plant. More specifically, this paper describes the development of models for steam heaters, a common component in any chemical process. The condensing steam heaters dynamically modeled in this work are shell and tube heat exchangers with the condensing steam on the shell side. Two variations of the model are developed, one for heating a gas stream where the thermal mass of the gas is neglected, and one for heating a liquid stream where the thermal mass of the heated fluid may not be neglected. Predictions from the gas heater model compare excellently with data collected from transient experiments on two industrial heat exchangers at the General Electric Coal Gasification Process Evaluation Facility. These two heat exchangers differ widely in their design and operating conditions. Consequently, the good agreement that was found between the model predictions and experimental data shows the wide applicability of the model. 2 references, 3 figures.

25184 (DOE/ET/13397—18) Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, February-April 1983. Tarrer, A.R.; Guin, J.A.; Curtis, C.W. (Auburn Univ., AL (USA). Coal Conversion Lab.). Mar 1984. Contract AC22-79ET13397. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84008202.

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This report examines the catalytic and thermal liquefaction of coal to determine the nature and extent of pore diffusion limitations in various stages of coal liquefaction. It was found that the progressive sequence according to the model Coal + α oil → Preasphaltenes → Asphaltenes → Oils; Coal → Gas satisfactorily represented the kinetics of thermal as well as catalytic liquefaction of coal. The pseudo-first order rate constants were determined for catalytic as well as thermal runs. The reactions (1) coal + α oil → preasphaltenes and (2) coal → gases, were found to be thermal in nature. The reactions, preasphaltenes → asphaltenes and asphaltenes → oils were strongly influenced by the powdered catalyst; however, the reaction, preasphaltenes → asphaltenes, was severely limited by pore diffusion rates in the catalyst pellet.

25185 (DOE/ET/13397—19) Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, May-July 1983. Tarrer, A.R.; Guin, J.A.; Curtis, C.W. (Auburn Univ., AL (USA). Coal Conversion Lab.). Mar 1984. Contract AC22-79ET13397. 139p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84008010.

This report examines liquid-phase adsorption as a possible method of studying the interactions between coal liquids and hydrotreating catalysts. The duel purposes of this work are to develop a method to determine specific surface areas of porous catalysts and to examine how compounds commonly found in coal liquids are adsorbed on hydrotreating catalysts. The liquid-phase adsorption studies were performed at room temperature in tubing bomb reactors.

Adsorption isotherms obtained from these experiments were assumed to follow Langmuir-type behavior. Compounds used in these studies included PNA compounds, a basic nitrogen containing compound, and an acidic oxygen containing compound. Various commercial grade catalysts as well as presulfided $CoMo/Al_2O_3$ and presulfided iron oxide were used as adsorbents. Experiments have shown that quinoline, a basic nitrogen containing compound, appears to be an excellent compound for surface area determination via liquid-phase adsorption. Adsorption of compounds such as pyrene, a PNA compound, and phenol, an acidic oxygen containing compound, may be used to determine the relative areas of different types of sites on catalyst surfaces. The sensitivity of this liquid-phase adsorption technique was evaluated by adsorbing different solutes on various catalyst surfaces. This technique shows that the adsorptivity of different coal liquids is a distinct function of the individual properties of the adsorbate as well as the properties of adsorbent used. Comparison of the adsorption properties of these coal liquids on various adsorbents may give insights as to how they adsorb on hydrotreating catalysts, how they compete for the active catalyst sites, and what types of sites the adsorbed molecules occupy. 29 references, 37 figures, 41 tables.

25186 **(DOE/ET/14928—1540) Experimental evaluation of the steady state and dynamic performance characteristics of the interactive units of a coal gasification process. Quarterly report, 4 April 1983-3 July 1983.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Aug 1983. Contract AC21-80ET14928. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84005447.

During this reporting period, the 1983 Experimental Program was completed in a series of three test runs. The first run focused on the continued evaluation of system effluents, both gaseous and liquid. Data were developed to permit the finalization of system mass balances. The second test run included transient tests designed to permit verification of the component and system dynamic models which were developed as part of this program. One of the transient tests evaluated the thermal and steam condensation response of several lengths of pipe in the facility. A series of transient tests were performed to correlate the resaturator dyanamic model was the basis of the correlation technique. Also during the second test run, the combustion characteristics of the clean fuel gas from the process were measured over a wide range of conditions. The third test run focused on operation of the Process Evaluation Facility (PEF) system as if it were the fuel plant for a full-size, Integrated Gasification Combined Cycle (IGCC) power plant operating on a utility grid. These tests demonstrated the viability of operating an IGCC power plant under the changing load condition imposed by the utility environment. The systems performed smoothly with no adverse situations. This test series confirms not only the outstanding dynamic performance of IGCC plants, but also provides an excellent demonstration of the applicability of the dynamic analytical models to specific advanced control logic for this type of power plants. 6 figures, 6 tables.

25187 **(DOE/MC/14400—1603) Development of BEACON technology. Quarterly report, October-December 1981.** (TRW Energy Systems Group, Redondo Beach, CA (USA)). Sep 1982. Contract FC21-80MC14400. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011419.

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The BEACON process involves the catalytic deposition of a highly reactive carbon from a gas stream containing carbon monoxide. The carbon-depleted gas is combusted with air to produce power, and the carbon is reacted with steam to produce methane. Laboratory multicycle tests with K1 and K2 catalysts were completed this quarter. Both catalysts were cycled through 40 deposition and steaming cycles. Both catalysts showed good stability. The K1-based material was found to be more active than the K2-based material, both for carbon deposition and for steaming. Gas conversion proceeded to near-equilibrium levels for both catalysts. Investigation of the effects of multicycle operation and carbon loading levels on catalyst C77-K2 stability continued this quarter. Testing in a 1-inch quartz fluid bed reactor showed no significant catalyst deterioration after 40 cycles at low carbon loadings. However, significant morphology changes occurred at higher carbon loadings. During testing in a new 1-1/2 inch diameter fluid bed reactor, there was evidence of inadequate mixing: large variations in carbon loading within the bed were observed, and the bed plugged at the higher carbon loadings. Multicycle testing of K1 and K2 catalysts continued in the 4-inch diameter fluid bed reactor. The K1 catalyst showed no decrease in catalytic activity after 9-1/2 of the planned 30 cycles. The K2 catalyst showed evidence of contamination from an undetermined source, and testing was discontinued after 9 cycles. A tandem reactor system which will circulate solids between a carbon deposition reactor and a carbon steaming reactor is now being designed for future catalyst testing. 19 figures, 21 tables.

25188 **(DOE/MC/14400—1604) Development of BEACON technology. Quarterly report, January-March 1982.** (TRW Energy Development Group, Redondo Beach, CA (USA)). Dec 1982. Contract FC21-80MC14400. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011421.

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The BEACON process involves the catalytic deposition of a highly reactive form of carbon from a gas stream which contains carbon monoxide. The carbon-depleted gas is combusted with air to produce power, and the carbon is reacted with steam to produce methane or hydrogen. Process conditions favoring the production of hydrogen were explored this quarter. Excess steam was found to suppress methane formation, and reduction of catalyst methanation activity was demonstrated. The effect of carbon loading on the physical stability of catalyst C77-K2 and the effect of trace sulfur levels on the chemical stability of the catalyst were examined. The carbon loading tests did not show the catalyst breakup that was expected. Tests of chemical stability of the catalyst in the presence of sulfur-containing gases showed a decline in performance even at levels as low as 4 ppM. Experiments conducted using a Paraho-type oil shale retort offgas as a feedstock showed that acceptable performance could be obtained by removing carbon dioxide from the feedgas. Design of the tandem two reactor system is continuing, along with cold flow testing of the proposed solids transfer system. A simplified thermodynamic analysis of the BEACON process shows that BEACON's increased efficiency over competing processes results from more hot gas going to the turbine with less power required to compress the air for combustion. 16 figures, 13 tables.

25189 **(DOE/MC/14400—1605) Development of BEACON technology. Quarterly report, April-June 1982.** (TRW Energy Development Group, Redondo Beach, CA (USA)). Mar 1983. Contract FC21-80MC14400. 73p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011420.

The BEACON process involves the catalytic deposition of a highly reactive form of carbon from a gas stream which contains carbon monoxide. The carbon-depleted gas is combusted with air to produce power, and the carbon is reacted with steam to produce methane or hydrogen. Experiments were continued this quarter with the objective of improving the carbon deposition efficiency using a Paraho retort off-gas mixture. Analysis has shown that the use of the Paraho off-gas to make hydrogen would be attractive if the ratio of the heat content of the feedgas to the heat content of the hydrogen produced is less than 3. Experimental conditions to achieve this ratio have been established. Recent work had shown that the volume of a BEACON supported catalyst bed increased with an increase in carbon loading level. Four series of experiments were performed where sieve analyses were made after one or more BEACON process cycles. These tests showed that the volume expansion is due to an increase in the number and size of the larger catalyst particles. The bench-scale testing of unsupported catalysts concentrated in two areas: (a) the completion of batch testing in the 4-inch reactor, and (b) the construction of the Tandem Reactor Unit which will permit the transfer of solids between the carbon deposition and steam gasification reactors during testing. It was found that a second stage of steaming enhanced the methane yield. Approximately 80% of the construction and instrumentation of the Tandem Reactor Unit was completed during the quarter. A conceptual design was completed for an Integrated Test Facility (ITF)

which would permit research on the BEACON process at a scale sufficient for scale-up. 17 figures, 14 tables.

25190 **(DOE/MC/14400—1606) Development of BEACON technology. Quarterly report, July-September 1982.** (TRW Energy Development Group, Redondo Beach, CA (USA)). Apr 1983. Contract FC21-80MC14400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011422.

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The BEACON process involves the catalytic deposition of a highly reactive form of carbon from a gas stream which contains carbon monoxide. The carbon-depleted gas is combusted with air to produce power, and the carbon is reacted with steam to produce methane or hydrogen. Catalyst development at SOHIO showed that larger quantities (4 kg) of satisfactory C77-K2 catalyst could be prepared. Several preparation modifications were studied, and, although some showed satisfactory results, none were sufficiently attractive to be adopted. Studies were conducted at SOHIO on promoters for the C77 type catalyst that would increase hydrogen production and suppress methane. Several were found, one of which operates at 550°C. The C77-K1 catalyst was found not to be satisfactory for converting oil shale retort off-gas to hydrogen. The C77-K2 catalyst does perform this conversion under economically attractive conditions. Physical characteristics for sieve fractions of a C77-K2 catalyst were determined. A new catalyst support was evaluated and found to be unsatisfactory. Tandem Reactor development proceeded at TRW with completion of construction and the test readiness review and the initiation of shakedown testing. Good fluidization with a C77-K2 catalyst was achieved with the installation of a stirrer in a 1.5-inch reactor at SOHIO. Good steady state carbon deposition and steaming rates were achieved over a 10 cycle test. 6 figures, 11 tables.

25191 **(DOE/MC/14400—1607) Development of BEACON technology. Quarterly report, October-December 1982.** (TRW Energy Development Group, Redondo Beach, CA (USA)). Apr 1983. Contract FC21-80MC14400. 47p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011423.

The BEACON process involves the catalytic deposition of a highly reactive form of carbon from a gas stream which contains carbon monoxide. The carbon-depleted gas is combusted with air to produce power, and the carbon is reacted with steam to produce methane or hydrogen. During the quarter both SOHIO and TRW worked on catalysts which would suppress methane formation during steaming thus increasing the amount of hydrogen formed. At SOHIO a C77-K2 catalyst promoted with a Class II compound showed promise in laboratory tests for suppressing methane. At TRW a K-1 unsupported catalyst promoted with 10% of Additive F maintained methane suppression over 30 cycles in laboratory scale tests. Shakedown of the Tandem Reactor Apparatus was completed and testing was initiated under quasi-continuous transfer of solids between reactors. Nine short term tests were performed with K-1 based BEACON solids. The data from these tests indicate that the Tandem Reactor concept is valid and BEACON solids can be transferred efficiently in the fluidized state between the deposition and gasification reactors. A preliminary analysis of the potential of a BEACON combined cycle/hydrogen system with a hydrogen fuel cell has been performed. The BEACON process can be used to coproduce hydrogen and electric power, and the efficiency of the overall system is quite high when the electricity is produced by a combined cycle power system. If fuel cells are used to convert the hydrogen to electricity then a system for making only electricity results, and such a system gives an overall efficiency of 54%. 7 figures, 14 tables.

25192 **(DOE/METC/SP—201) Surface coal gasification.** (USDOE Morgantown Energy Technology Center, WV). Apr 1983. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84003048.

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Project history, project goals, process description, fiscal 82 accomplishments and current status and projected work are presented for each of the following: (1) Bi-Gas two stage entrained-flow gasification pilot plant; (2) Westinghouse ash-agglomerating fluidized bed gasification PDU; (3) Mountain Fuel Resources entrained-flow gasification PDU; (4) Morgantown Energy Technology Center dry-bottom fixed-bed gasification pilot plant; (5) Grand Forks Project Office slagging fixed-bed gasification pilot plant; (6) General Electric fixed-bed gasifier and performance evaluation facility; (7) Mining Industrial Fuel Group fixed-bed gasifier; and (8) Community Area New Development Organization fixed-bed gasifiers. In addition, a technology crosscut discussion, which highlights the technical problems and issues common to the operating plants is presented. 17 figures, 11 tables. (ATT)

25193 **(DOE/OR/03054—13) Critical Technology List update. Final technical report.** (International Coal Refining Co., Allentown, PA (USA)). Mar 1983. Contract AC05-78OR03054. 56p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011319.

ICRC has reviewed and updated its List of critical technology. The List comprises all proposed SRC-I Demonstration Plant equipment whose use has been determined to involve some degree of potential safety, performance, or environmental risk. ICRC has subjected equipment on the Critical Technology c to special technical review to ensure the highest possible level of quality and lowest cost commensurate with acceptable overall risks. Equipment or equipment systems still considered to be high risk are the following: Coal Slurry/Hot Oil Heat Exchangers, Coal Slurry Heaters, Second-Stage Feed Heaters, Vacuum Tower Heater, Vacuum Column, SRC/Light SRC Stripper - CSD, Severe Service Valves, Wastewater Reuse System, and the Solid Waste Disposal System. Equipment systems or pieces of equipment that have been downgraded to a lower risk category are the following: Coal Weigh-Feed System, Coal Slurry Dissolvers, Coal Dissolver Effluent Separator, and LC-Fining Reactors. Finally, ICRC has determined that many types of equipment are no longer Critical Technology, and has therefore removed them from the List.

25194 **(DOE/OR/03054—56) Subcontracted R and D final report: gasifier feed preparation (Program Area 15.1.1).** (International Coal Refining Co., Allentown, PA (USA)). Sep 1983. Contract AC05-78OR03054. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011553.

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This report summarizes attempts made by the Wilsonville Advanced Coal Liquefaction Facility to compact and granulate Kerr-McGee ash concentrate (KMAC) samples to be used in Texaco coal gasification tests. An earlier study had indicated that KMAC could not be used economically as a feedstock for Texaco gasification unless it was agglomerated. Agglomeration increases the concentration at which the KMAC can be pumped in water to the gasifier. During Wilsonville's tests, problems were encountered in compacting the material because most samples were too dry and aerated too easily. Addition of about 5 wt % water eliminated this problem. However, because the water was mixed in with the KMAC manually, nonuniform blending and low production rates resulted. Texaco examined the samples produced at Wilsonville and found they contained excessive amounts of material that was too coarse (i.e., +20 mesh). The fraction that was less than 20 mesh was initially acceptable in most samples tested; however, Texaco later found that the agglomerates disintegrated when they were stirred overnight in water. Thus, additional work would be required to increase the cohesive strength of the agglomerated KMAC. However, this program was discontinued in April 1981 because of DOE's withdrawal of support for the Texaco KMAC gasification tests.

25195 **(DOE/OR/03054—70) SRC-I naphtha reforming study. Part 1: SRC-I naphtha distillation and hydrotreating. Part 2: SRC-I naphtha reforming. Final technical report.** Oyekan, S.O.; Townsend, G.J.; Mathur, K.N.; Sopko, J.S. (UOP Process Div., Des Plaines, IL (USA)). Sep 1983. Contract AC05-78OR03054. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010983.

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Naphtha derived from the first stage, Solvent Refined Coal unit of the Wilsonville coal liquefaction pilot plant was fractionated and hydrotreated to produce a naphtha with a boiling range of 190°F to 390°F. Drastic reductions in the sulfur, nitrogen and oxygen contents of the SRC-I naphtha were accomplished via severe hydrotreating at 1.0 LHSV, 1000 psig, 3100 SCF/bbl recycle rate and 700°F. The resultant product of the hydrotreating process has sulfur and nitrogen contents that are well within bimetallic catalysts' reformer feed specifications of <1.3 wppM sulfur and <1 wppM nitrogen. Hydrogen consumption was, however, high at 1300 SCF/bbl. Naphtha from the first stage, solvent refined coal unit of the Wilsonville coal liquefaction pilot plant has been examined for upgrading to gasoline blendstock or benzene, toluene, and xylene (BTX). The reformability of the hydrotreated SRC-I naphtha over Engelhard's E603 catalyst has been established via: (1) yield/octane test at 350 psig, 2 WHSV, 6000 SCF/bbl recycle rate and (2) catalyst activity and selectivity stability studies at 160 psig, 4 WHSV, 4000 SCF/bbl recycle rate and 100 C_5+ RONC. The results show 85.5 to 87.0 vol % C_6+ yield, 75 wt % aromatics and a yield of 1600 to 1720 SCF/bbl of hydrogen. The data also show excellent E603 activity and selectivity stability in the reforming of SRC-I naphtha. Based on data from the experimental programs, an economic comparison was made for the reforming of SRC-I and Arabian light naphthas which showed an increased product value of $1.63 to $2.28 per barrel for the reforming of SRC-I naphtha.

25196 **(DOE/OR/03054—88) Phenol extraction studies: solvent screening, tar acid removal, and organic volatilization. Final technical report.** Luthy, R.G.; Campbell, J.R. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). Jan 1984. Contract AC05-78OR03054. 83p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84011851.

This report summarizes three studies to assess the feasibility of pretreating wastewater from the SRC-I Demonstration Plant with solvents to remove phenolic materials. One series of tests evaluated the extraction efficiency of three solvents (diisopropyl ether, methyl isobutyl ketone, and N-butyl acetate) on SRC-I wastewater obtained from the Ft. Lewis pilot plant. Solvent extraction was deemed feasible, but not without resolving the effect of pH on extraction and the fate of tar acids during extraction. Tar acids are a complex mixture of unidentified organic compounds that can be precipitated out of water at an acidic pH. A second set of extraction screening experiments was run with SRC-I hydrotreater unit and H-Coal wastewaters; tests were also run with those samples and SRC-I water to evaluate tar acid removal at different pH values. Phenol removal from SRC-I water was feasible but pH-dependent. In general, the extraction characteristics of phenol, pyridine, and aniline with the various solvents were consistent with other experimental observations for coal-conversion wastewater. The three samples exhibited markedly different tar acid properties. A third series of tests determined the amount of tar acid material that can be removed by acidifying the different wastewaters, and how solvent extraction affected the quantity of tar acid. Results showed that acidification of the raw SRC-I wastewater removed about 10 g/L of tar acid, and that H-coal wastewater contained much less tar acid. Solvent extraction did reduce the quantity of tar acid significantly. Solvent extraction also markedly reduced the amount of organics volatilized during steam-stripping. Screening tests showed reductions ranging up to a factor of approximately 20 for extracted water, free of residual solvent, in comparison with raw wastewater. 11 references, 8 figures, 21 tables.

25197 **(DOE/OR/03054—98) SRC-water slurry rheology. Final technical report.** Tewari, K.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Feb 1984. Contract AC05-78OR03054. 40p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011883.

SRC-water slurries exhibit properties that qualify them for use as fuel in conventional oil-fired combustion facilities. However, to date, the slurries tested have shown storage instability, which requires constant agitation and recirculation to avoid sedimentation in the storage tanks. High viscosities of the material being evaluated hampered the test performance. A program was instituted to better understand the variables responsible for viscosity and static stability of these slurries. Effective additives and concentrations were determined. This report presents laboratory data demonstrating that solid concentration, particle size distribution, additive concentration, and slurry preparation technique influence the viscosity and stability characteristics of an SRC-water slurry. 7 references, 12 figures, 11 tables.

25198 **(DOE/PC/40091—T8) Development of significantly improved catalysts for coal liquefaction and upgrading of coal extracts. Quarterly progress report No. 8, July 1-September 30, 1983.** Wolfson, S.L.; Kutzenco, P.D.; Preston, W.J.; Graham, S.W.; Brinen, J.S.; Muchnick, T.L.; Hyman, D. (American Cyanamid Co., Stamford, CT. Chemical Research Div.). 1983. Contract AC22-81PC40091. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010742.

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(1) Experimental bead catalysts were tested for extract-upgrading performance. Equations were developed relating conversion of cyclohexane insolubles and sulfur removal to catalyst physical and chemical properties. Activity is enhanced by high MoO_3, high surface area, and low Na_2O. (2) Commissioning of the CSTR aging unit was completed and operations commenced with two thermal and one catalytic baseline run. Equipment modifications are necessary to achieve required continuity. (3) Improvements in the quantitative analysis capabilities of an electron microprobe system are described. The technique can be applied to experimental bead catalysts.

25199 **(DOE/PC/40784—T3) Dependence of liquefaction behavior on coal characteristics. Part V. Penetration of solvent vapor into coal particles. Final technical report, March 1981-February 1984.** Hsieh, S.T.; Duda, J.L. (Pennsylvania State Univ., University Park (USA)). Apr 1984. Contract AC22-81PC40784. 144p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84008012.

The investigation of the sorption of solvent vapor into high volatile bituminous coal at temperatures up to 175°C indicates that the solvent weight gain involves a complex coupling of several phenomena including adsorption, sorption into the coal matrix, capillary condensation and extraction into the condensed vapor phase. It appears that the sorption in untreated coal is dominated by capillary condensation induced by solvent extraction. As a result, an equilibrium state is not attainable. This extraction mechanism can be eliminated by the preextraction of the coal particles with pyridine. Vapor sorption experiments conducted on pyridine-extracted coal can be used to obtain information concerning the adsorption process and the process associated with the diffusion of the solvent molecules into the coal matrix. Vapor sorption studies conducted on pyridine-extracted coal particles indicate that the sorption process involves a coupling of adsorption, molecular diffusion and a relaxation of the coal structure to a new state. The results have been compared with models derived to describe the coupling of molecular diffusion and polymer chain relaxation in glassy polymers. The thermodynamics of solvent sorption into coal particles is complicated by the presence of severe hysteresis effects. The amount of solvent sorbed by a coal particle is not only a function of solvent activity but depends upon the past history of the sorption process which influences the structure of coal. As a result, fits all the data to various models were obtained but the resulting parameters had doubtful physical significance. (LTN)

25200 **(DOE/PC/40785—11) Exploratory study of coal conversion chemistry. Quarterly report No. 11, November 19, 1983-February 18, 1984.** Ross, D.S.; McMillen, D.F.; Chang, S.J.; Hum, G.P.; Green, T.K.; Malhotra, R. (SRI International, Menlo Park, CA (USA)). Mar 1984. Contract AC22-81PC40785. 42p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011843.

Work performed under Task A is reported in two parts: Part 1 describes the promotion, by the addition of real coals, of the cleavage of strong bonds in model coal structures, as predicted by our previously proposed hydrogen-transfer/bond-cleavage mechanism; and Part 2 is an analysis that reconciles the reported slow isotopic exchange (C) between tetralin and naphthalene with accepted or proposed mechanisms of radical generation and hydrogen trans-

fer in such systems. Efforts in Task B, Conversion in CO/H_2O Systems involved a study of the conversion characteristics of Eastern Province bituminous coals in CO/H_2O. All coals were subjected to identical reaction conditions of 400°C/20 min in CO/H_2O at pH 13. The amount of CO that reacted was nearly identical in all runs, indicating that the extent of water-gas-shift reaction is independent of the coal used in the reaction. The amount of toluene-soluble material varied widely from 85% (dmmf) for an Ohio No. 9 coal to only 3% for a Pocahontas No. 3 coal.

25201 **(DOE/PC/40797—T3) Study of multiphase flow useful to understanding scaleup of coal liquefaction reactors. Technical progress report, December 1 1983-February 29, 1984.** Knickle, H.N. (Rhode Island Univ., Kingston (USA). Dept. of Chemical Engineering). Mar 1984. Contract FG22-81PC40797. 38p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010039.

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Based on the results of this study a number of conclusions may be drawn about the effect of non-Newtonian liquids on two phase flow parameters: (1) Rheological properties can effect gas holdup in bubble columns. The way in which these properties affect gas holdup depends on the flow pattern the column is operating in. In the bubble flow pattern, gas holdup increases with viscosity at a particular gas velocity. In the bubble-slug or hetergeneous flow pattern, gas holdup generally decreases with viscosity. (2) Liquid velocity effects gas holdup in the bubble flow pattern. Increasing the liquid velocity reduces the gas holdup at any particular gas velocity. This effect is accentuated by increased viscosity. (3) The bubble to bubble-slug transition is dependent on viscosity. The gas velocity of the transition decreases with increasing gas viscosity. There is no effect of liquid velocity on this transition however in the range studied. (4) The effect of alcohol on two-phase flow parameters was extreme. Holdup in the bubble flow pattern was very high, often greater than 0.5 at peaks. The bubble to bubble-slug transition occurred at higher gas velocties than in aqueous CMC solutions. There also appeared to be competing effects between alcohol and CMC concentrations. 45 references, 14 figures and 1 table.

25202 **(DOE/PC/40799—T9) Heteroatom speciation in coal liquefaction via FTIR coupled with liquid chromatography. Quarterly progress report, October 1-December 31, 1983.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1984. Contract FG22-81PC40799. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011131.

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The objectives of the research are (1) evaluate the potential of FT-IR for qualitative functional group detection in chromatographic fractions of highly polar materials, (2) develop separation techniques with the aid of FT-IR detection for concentration of oxygen, nitrogen and sulfur functionalities in synfuels, (3) describe and quantify the various heteroatom functionalities in selected solvent refined coal fractions, (4) place speciation techniques on-line with chromatographic separations, (5) compare quantitative speciation information obtained from LC-FTIR with established fluorine tagging techniques regarding model compounds and synfuels. 23 figures, 5 tables.

25203 **(DOE/PC/40810—9) Synthesis of oligomeric models of coal derived materials for use with GPC calibration. Quarterly report, January-March 1984.** Baltisberger, R.J.; Jones, M.B. (North Dakota Univ., Grand Forks (USA)). Apr 1984. Contract FG22-81PC40810. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011520.

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The purpose of this study was to develop a set of GPC calibration standards for asphaltene and preasphaltene analysis. A series of oligo(arylether) (1) and oligo(arylmethylenes) (2) from 170 to 580 g/mole were prepared via modified Ullmann-type reactions (ethers) and condensation of an aryl lithium derivative with an aryl carboxaldehyde, followed by reduction of the resulting carbonol (methylenes). These compounds were examined as molecular weight calibration standards for GPC analysis. A nearly linear plot was found to exist between the logarithm of molecular weight times mol fraction hydrogen versus retention volume with THF as the solvent. Further this plot was coincident with commercial polystyrene standards (600 to 2000 g/mol) and with the majority of our lignite derived asphaltenes and preasphaltenes. Work in our laboratory suggests that universal calibration plots for the gel permeation chromatographic (GPC) analysis of lignite derived preasphaltene and asphaltene liquefaction products are possible for determining number and weighted average molecular weight values. The data indicates that the acid content (OH mmol/g) and the hydrogen content (mole fraction or H/C mole ratio) are representative of the solubility parameters of the asphaltenes/preasphaltenes. Universal calibration plots based on the logarithm of the hydrodynamic volume, number average molecular weight times hydrogen content, result in a smooth curve coincident with polystyrene standards, model compounds, and lignite derived asphaltenes/preasphaltenes. The data supports an hypothesis that two factors, degree of condensation of the aromatic carbons and acetate content, determine the size-molecular weight relationships of the coal derived molecules. 19 references, 5 tables, 9 figures.

25204 **(DOE/PC/50786—8) Facile reaction/extraction of coal with supercritical fluids. Quarterly technical progress report, January 1-March 31, 1984.** Venier, C.G.; Squires, T.G. (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 20 Apr 1984. Contract FG22-82PC50786. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010560.

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Arylmethyl phenyl ethers undergo competing reactions when treated with Lewis acids in benzene solvent. Apparently, benzene is insufficiently reactive to compete with intramolecular (intrapolymer) nucleophiles and, consequently, no increase in solubility accompanies the cleavages of ether links upon addition of benzene. When better nucleophiles, naphthalene and phenanthene, are provided, carbonium ions generated from ether cleavages are capped and the product is lower in molecular weight and more soluble. It is worth noting that the naphthalene (k/sub rel/ = 300) is nearly as good a trap as the phenol (k/sub rel/ = 450). Since hydroxylic solvents will level the acid strength of BF_3 to that of $ROBF_3^-H^+$ ahd hydrocarbons would not, the acid-catalyzed bond cleavages necessary for unlinking coal may in fact be faster in BF_3-arene than in BF_3-phenol. While we have not yet extended these results to coals, we believe that the combination of a relatively mild Lewis acid catalyst, BF_3, with a good carbonium ion trap, naphthalene, will allow selective cleavage and capping of aryl alkyl ether bonds. 3 references, 2 figures, 3 tables.

25205 **(DOE/PC/50798—7) Catalyzed gasification of coal: isotope and XPS studies.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 15 May 1984. Contract FG22-82PC50798. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011884.

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This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways. X-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate.

25206 **(DOE/PC/50800—T6) Transport and relaxation processes in supercritical fluids. Technical progress report, December 31, 1983-March 31, 1984.** Jonas, J. (Illinois Univ., Urbana (USA)). 1984. Contract FG22-82PC50800. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010468.

Our experiments on the temperature and pressure dependence of self-diffusion in supercritical toluene were motivated by the interest in the system for extraction of the liquids generated when coal is heated to approximately 400°C. Toluene is a convenient solvent to use for this process, as its critical temperature is 318°C, and its critical pressure is 42 bar. Typically, the operating temperature for the process is between 350 and 450°C, with pressures of about 100 to 200 bar. Experiments investigating the use of supercritical fluid extraction in the process of coal liquefication were described recently (Chemical and Engineering News, 61, 18 (1983)), and involve study of the basic steps involved in the extraction process. The goal of our experiments was to provide fundamental data on transport in supercritical toluene at the conditions of interest. These data should help in the design and interpretation of extraction processes using supercritical toluene. The measured self-diffusion coefficients were on the order of $10^{-4}cm^2/sec$, a value typical for compressed supercritical fluids. The variation of the diffusion coefficient can be explained in terms of the changes in density with temperature and pressure. As the temperature is raised at constant pressure, density decreases and therefore diffusion becomes faster; as pressure is increased at constant temperature, density increases and diffusion slows down. The effect of increasing temperature is more pronounced at lower pressures, since the corresponding density change is greater. At higher pressures, the temperature dependence of the density is not as large, and we do not see such a variation in the diffusion coefficient. This explains the difference in the curvature of the 300° and 375° isotherms in Figure 1. 6 figures.

25207 **(DOE/PC/60015—12) Separation and characterization of coal derived components.** Hurtubise, R.J.; Silver, H.F. (Wyoming Univ., Laramie (USA)). 11 Apr 1984. Contract AC22-83PC60015. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010414.

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Eight samples rich in monohydroxyl aromatics and dihydroxyl aromatics were submitted to SRI International for field-ionization mass spectral analyses. An important breakthrough was made when it was discovered that a μ-Porasil column and carbon tetrachloride: dimethyl sulfoxide mobile phases could be used to separate preasphaltenes-1 and preasphaltenes-2 in F-51. For F-45, preasphaltenes-1 and about 65% of preasphaltenes-2 could be separated. In addition, with a μ-Bondapak NH_2 column and chloroform:2-propanol mobile phases the monohydroxyl aromatics and dihydroxyl aromatics in oils and asphaltenes were separated. Encouraging results were obtained for the compound class separation of hydroaromatics and polycyclic aromatic hydrocarbons, aromatic nitrogen compounds, and hydroxyl aromatics using a Nucleosil NO_2 column and n-heptane:chloroform mobile phases. 3 references, 4 tables, 4 figures.

25208 **(DOE/PC/60045—T2) Integration of advanced preparation with coal liquefaction. Second quarterly technical progress report, January 1-March 31, 1984.** Steedman, W.G.; Longanbach, J.R.; Muralidhara, H.S.; Folsom, D.W.; Droege, J.W.; Chauhan, S.P. (Battelle Columbus Labs., OH (USA)). 24 Apr 1984. Contract AC22-83PC60045. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010476.

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Standard reaction conditions of 427 C, 5 minutes reaction time, 2:1 solvent/coal ratio and 1000 psig (r.t.) hydrogen overpressure result in good, but not maximum, conversions to THF soluble with both Illinois No. 6 and Wyodak (upper seam) coals. The cumulative effects of the pretreatment steps were also examined using feedstocks which were dried in a vacuum oven at room temperature under nitrogen before liquefaction to remove the effects of moisture. Chloride removal followed by drying had a positive effect on liquefaction. Oil agglomeration followed by drying also improved liquefaction reactivity significantly. Solvent drying also resulted in a small increase in liquefaction reactivity. The overall reactivity of coal treated in sequence with each pretreatment step was slightly less than that of the dry ground coal. Liquefaction under a high partial pressure of hydrogen sulfide in hydrogen also results in a significant increase in conversion to THF solubles. 1 reference, 12 figures, 7 tables.

25209 **(DOE/PC/60048—2) Advanced direct coal liquefaction. Quarterly technical progress report No. 2, December 1983-February 1984.** Paranjape, A.S. (Kerr-McGee Corp., Oklahoma City, OK (USA)). 30 Apr 1984. Contract AC22-83PC60048. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011720.

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Five Bench-Scale coal liquefaction runs were completed with Wyoming subbituminous coal in a two-stage process scheme. In this process scheme, LDAR, the lighter fraction of ash-free resid, was fed to the catalytic stage prior to its recycle to the thermal stage, whereas DAR, the heavy fraction of the deashed resid, was directly recycled to the thermal stage without any intermediate processing step. The results indicate that increasing coal space rate in the dissolver resulted in lower coal conversion and reduced distillate yield in this process configuration. The coal conversions decreased from 92 wt% to 89 wt% (MAF coal) and the distillate yield was reduced from 50 wt% to less than 40 wt% (MAF coal), as the coal space velocity increased. Attempts to duplicate the yields of Run 32, at comparable process conditions in Runs 37 and 38, were unsuccessful. Several process parameters were investigated but failed to show why the yields of Run 32 could not be duplicated. Valuable process related information was gained as a result of process parameter studies completed during these runs. At comparable process conditions, coal conversions were lower by about 3 to 4 relative percent and were only in the 87 wt% (MAF coal) range. Similarly, the distillate yield was about 40 wt% (MAF coal) which is about 10 wt% lower than observed in Run 32. Although no exact cause for these results could be determined, it appeared that the H/C atomic ratio of the solvent and possibly the flow pattern (plug-flow versus back-mixed) could have affected the coal conversion and quantity of distillate product produced. A significant decrease in coal conversion of 4 to 5 wt% was observed when the disposable catalyst (iron oxide) was removed from the reaction mixture and therefore substantiates the need for a disposable catalyst in the liquefaction of Wyoming subbituminous coal.

25210* **(DOE/PC/60053—T1) Socio-economic subsidence, transportation and legal ramifications of potential coal liquefaction plant sitings. Quarterly report, October 1-December 31, 1983.** Rose, A.Z. (West Virginia Univ., Morgantown (USA). Dept. of Mineral Resource Economics). 1983. Contract FG22-83PC60053. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010318.

A good deal of time was spent critically reviewing the academic and technical literature on socioeconomic impacts of synfuels. The study team decided to confine its attention to solvent refined coal (SRC) and Fisher-Tropsch technologies. In the absence of predictive models we also decided to pursue a scenario approach to the analysis. This calls for examining several alternative capacity levels and plant sites. The capacity range will be from one to ten commercial size plants. It would be unreasonable to assume that ten plants could be located in Monongalia County, so the study area was expanded to include an 11-county area in north central West Virginia (US Bureau of Economic Analysis Region 61). The core of the methodology is an input-output (I-O) model.

25211 **(DOE/PC/60054—T2) Coal liquefaction: investigation of reactor performance, role of catalysts and PCT properties. Quarterly progress report, January 1-March 31, 1984.** Brainard, A.J.; Shah, Y.T.; Tierney, J.W.; Wender, I.; Bhattacharjee, S.; Joseph, S.; Seshadri, K.S. (Pittsburgh Univ., PA (USA)). 1984. Contract FG22-83PC60054. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010885.

A comprehensive program has been developed to predict the performance of coal liquefaction preheaters and reactors. The simulator is interactive and allows the user to input any linear kinetic network by specifying the reaction paths. The user must also specify the operating conditions and the physical dimensions of the units. The simulator then provides detailed information on the performance of each unit, the characteristics of each flow stream, and an overall summary of the products leaving each unit. A first draft report on the Fischer-Tropsch (F-T) synthesis has been prepared. The introductory section deals with the history of the F-T reaction

and early German work on F-T catalysts. The next section deals with the fundamentals of the conversion of synthesis gas to fuels and chemicals. The next section deals with SASOL technology and some of the developmental work that is ongoing at SASOL, in particular, work on slurry reactors, processes at SASOL for upgrading the primary products of the F-T synthesis to gasoline and diesel fuels and improvements in downstream operation. The final section deals with new catalysts that have been tested in the laboratory and on pilot plant scale for narrowing the product distribution in synthesis gas conversion. Reports on Viscosity of Coal Liquids and Slurries and Thermal Conductivity of Coal Liquids and Slurries have been prepared. Research has been initiated on two important areas of coal liquefaction, Heat of Reaction of Direct Coal Liquefaction and Dimensionless Numbers for Coal Liquids. Work on dimensionless groups of coal liquids has been primarily concentrated on the Prandtl number of various coal liquid fractions. 3 references.

25212 **(DOE/PC/60798—2) Catalytic hydrotreatment studies with model compounds. Quarterly report, January 1-March 31, 1984.** Satterfield, C.N.; Smith, C.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). Apr 1984. Contract FG22-83PC60798. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010552.

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In some of our recent hydrotreating studies with model compounds we found that with a mixture of quinoline and a phenol, the HDN rate of quinoline was enhanced. This was traced to the accelerating effect of water formed by the HDO reaction of the phenol. Water added as such also accelerated the HDN reaction in a reversible manner but some of the effects could not be repeated as the catalyst aged and the effects seemed to be dependent in a complex way on the presence or absence of H_2S. We have now repeated and extended those studies in a more systematic manner and have prepared a paper for publication describing those results. A copy is attached. An abstract follows: Studies at 375°C and 6.9 MPa showed that the presence of water, either added as such or generated in situ from an oxygenated compound increases the rate of hydrodenitrogenation on a $NiMo/Al_2O_3$ catalyst. The effect occurs in either the presence of or absence of H_2S. The degree of reversibility of activity when water is removed varies with conditions. Any remaining enhancement is removed by a standard resulfiding procedure that reduces the catalyst activity to the level it had before addition of water. The enhancement effect is much less than proportional to the water concentration, i.e., the first few kPa of water show the most noticeable effects. 3 references, 9 figures.

25213 **(DOE/PC/60799—1) Volatiles mass transport with particles of softened coal. Technical progress report, July 27, 1983-October 26, 1983.** Howard, J.B.; Oh, M.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1983. Contract FG22-83PC60799. 17p. (FE-MIT—60799-1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010863.

Volatiles products of coal pyrolysis are generated within the coal matrix and their transport out of the particle is accompanied by secondary reactions. In the thermal conversion processes of coal, the intraparticle transport and secondary reactions of volatiles can influence the distribution and yield of pyrolysis products significantly. Quantitative modeling of these processes requires analysis of the transport-kinetics coupling and treatment of the physical structure of the decomposing coal matrix. In the present work, a model for intra-particle chemical reactions, volatiles transport, and coal plasticity has been developed. The summary of the model description and its preliminary predictions are discussed in this report. Through the preliminary analysis of the model, the physical parameters of importance in the model are identified. Experiments to study these parameters will be discussed. 16 references, 2 figures.

25214 **(DOE/PC/60811—1-2) Mobile phase in coals: its nature and modes of release. Technical progress reports, September-November 1983 and December 1983-February 1984.** Given, P.H.; Derbyshire, F.J. (Pennsylvania State Univ., University Park (USA)). Apr 1984. Contract FG22-83PC60811. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010500.

Recent published studies indicate that coal is to be regarded as a two-component system, one component being a three-dimensional macromolecular network and the other an assembly of relatively small molecules located within the network and partly physically trapped there; this assembly of small molecules is termed the mobile phase. Our own earlier work revealed the presence in the mobile phase of a set of complex alkanes and long-chain alkyl aromatics that are released by liquefaction but not solvent extraction at low temperatures, and we propose to use these as markers. In the first stages of the present study, it is proposed to locate the mildest conditions under which these markers are released, comparing different classes of substance (polar and non-polar) and different coals. The information obtained will then be applied to studying the role of the mobile phase in the mechanism and kinetics of liquefaction. A set of 8 coals has been selected; all have been liquefied, and 7 have been extracted with a benzene/ethanol mixture with little retention of solvent by extract or residue. One coal has been further extracted with pyridine, and appreciable solvent is then retained after drying. The sum of the yields of extract, corrected for retention, and total conversion when the extracted residue is liquefied is greater than conversion when the unextracted coal is liquefied. A preliminary fractionation of liquefaction products by column chromatography has been made, and the fractions and extracts will shortly be analyzed by GC/MS with regeneration of chromatograms for selected single ions. 14 references, 1 figure, 7 tables.

25215 **(DOE/PC/60813—3) Hydrotreatment catalyst activity enhancement. Quarterly report No. 3, February 1-April 30, 1984.** Seapan, M.; Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 18 May 1984. Contract FG22-83PC60813. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011558.

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Tetralin and a mixture of 5% phenanthrene in Tetralin were hydrotreated in a two-stage trickle-bed reactor over a commercial Ni-Mo/Alumina catalyst at 350°C (662°F) and 10.34 MPa (1500 psia). These runs were compared with the runs where 100 ppM of titanium as titanocene dichloride were added to the feedstocks. Both the catalyst and oil samples were analyzed to measure the catalyst activity and coking. An additional run was made to check the reproducibility of experiments. Meanwhile, preliminary studies were conducted on the homogeneous reaction of Tetralin with titanocene dichloride. These studies indicate a slow homogeneous reaction occurring between Tetralin and titanocene dichloride at room temperatures. Hydrotreatment experiments show that the addition of titanocene dichloride to the feedstocks increases the H/C ratio of the products. Similar effects are also observed when the distillation curves of the products are compared. Addition of titanocene dichloride lowers the bubble point curves for both feedstocks. However, the effects on the coke formation depend on the hydrocarbon feedstock used. While the addition of titanocene dichloride decreases the coke formation for Tetralin/phenanthrene feedstock, it gives increased coking when only Tetralin is hydrotreated. Gas chromatographic analyses show that Tetralin is hydrogenated to cis- and trans-decalin, with small amounts of naphthalene formed as by-products of the process. Preliminary analysis of results excludes titanium or chloride as possible reasons of interference. It also indicates that probably the interference originates from some organic intermediates that are generated from titanocene dichloride. Further studies will be conducted to verify these results. 10 figures, 3 tables.

25216 **(DOE/PC/63032—T2) Bench-scale development of the TRW process for cleaning coal (Gravimelt Process). Quarterly technical progress report, 17 August 1983-4 November 1983.** (TRW Energy Development Group, Redondo Beach, CA (USA)). 23 Nov 1983. Contract AC22-83PC63032. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010293.

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This report presents progress for the first quarter of performance on Contract number DE-AC22-83PC63032. The effort includes Tasks 6 through 13 of a continuing program to demonstrate the TRW Gravimelt coal cleaning technology. During this reporting period most of the technical effort was performed under Task 6., key regeneration studies. The Mod II reactor from the previous

DOE project was utilized to produce approximately 1000 pounds of coal-caustic float material which will be utilized as the raw material for performance of Task 8 Washing Studies and also provides large samples for Task 6 Regeneration Studies. The stability of metal sulfides in fused caustic as contained in a nickel vessel was tested in order to provide confidence that experimental equipment would be available for the Task 6 studies. Anomalous ash results obtained for water Gravimelt coal were investigated by performing ashing at various temperatures and residence times. The results indicate that higher temperatures (950°C or more) will be required to burn off all non-mineral matter components. In order to determine the effect of water on fused caustic desulfurization and demineralization of coal, a technique was tested and validated for the reduction of water in fused caustic to a level of 0.1% w/w, calculated by difference, by using a combination of heating and purging for approximately 20 hours. It was found that no standard analytical techniques exists for the direct determination of water in caustic, but indirect methods were identified by contact with a caustic producer and the ASTM. Task 13, project management, a Task 6 through 8 project logic diagram was prepared to aid in developing an overall project plan. A detailed project plan was prepared and submitted to the Department of Energy for approval. 5 tables.

25217 **(EUR—7867-FR) New methods for obtaining industrial chemical compounds from the by-products of coal gasification and carbonisation processes (Report on ECSC contract 7220-EC/201).** Cypres, R. (Commission of the European Communities, Luxembourg). 1982. 131p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Coal pyrolysis at low temperatures and under hydrogen pressure was investigated. Mechanisms for obtaining lightweight aromatic hydrocarbons from coal hydrogenates by means of flash pyrolysis of alicyclic compounds was studied using mass spectrometry and by pyrolysis of compounds labelled with radioactive tracers (^{14}C and ^{3}H). Mechanisms for cracking naphthols and their hydrogenated derivatives were also studied. Finally, the physico-chemical properties of cresols and xylenols under pressure were established. (37 refs.)

25218 **(EUR—8065-DE) Carbonization of thermally pretreated coal with added pitch (Report on ECSC contract 7220-EB/110).** Habermehl, D. (Commission of the European Communities, Luxembourg). 1982. 68p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Industrial tests at the Bergbau-Forschung experimental coking plant have shown that the addition of pitch/bitumen to wet coking coal is operationally feasible. The carbonization of these blends invariably resulted in improved coke quality, but also in fairly low bulk densities and shrinkage of the charge. Experiments in preheating of coal blends with added pitch/bitumen had to be discontinued because of wall deposition in the entrainment pipes restricting gas flow. This meant that preheating would have to take place before addition of pitch, and it was found that this combination of the two improvement procedures produced coke of no better quality than either procedure alone.

25219 **(EUR—8125-FR) Lateral shrinkage of the charge and effects of expansion on coke oven walls (Report on ECSC contract 7220-EB/311).** (Commission of the European Communities, Luxembourg). 1982. 42p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The effects of particle size, carbonization rate and coal oxidation on the degree of lateral shrinkage measured at the end of the carbonization period were investigated. 400 kg coke oven tests and some additional laboratory tests were carried out. The role played by coke fissuration and expansion and how this affects lateral shrinkage is discussed.

25220 **(EUR—8382-EN) Chemical refining of coal (Report on ECSC contract 7220-EC/816).** (Commission of the European Communities, Luxembourg). 1983. 108p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Three areas have been investigated: coal liquefaction with supercritical fluids, liquefaction by extraction with high boiling liquid solvents, and the production of resins from coal-derived hydrocarbons. The processes are described.

25221 **(EUR—8383-EN) Studies of the factors controlling the formation and development of the porous structure of coke (Report on ECSC contract 7220-EB/814).** (Commission of the European Communities, Luxembourg). 1983. 127p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The object of the work described was to extend earlier studies by identifying and quantifying the principal charge properties and carbonization parameters which influence the coke porous structure. In laboratory studies ovens were used to obtain an appreciation of the processes involved in the formation and development of the porous structure of coke, and also mechanical properties. Scanning electron microscopy revealed the complex three-dimensional structure. It is hoped to use such studies to improve blast-furnace operation.

25222 **(EUR—8561-EN) Steel and fabrication requirements in coal utilization technologies - a review study (Report on ECSC contract 7210-KF/801).** Dulieu, D.; Tupholme, K.W.; Schoch, F.W.; Trunk, M. (Commission of the European Communities, Luxembourg). 1983. 257p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Processes of coal utilization (combustion, conversion) are surveyed and described. Coal gasification and liquefaction processes, and their material requirements and problems are covered, and the main areas of activity are identified. The projected expansion of the uses of coal is reviewed.

25223 **(LA—10024-MS) Review of valve designs for coal-gasification lockhopper service.** Cappiello, C.C.; Bennett, J.G.; Gac, F.D. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011010.

A key development area in the successful commercialization of coal conversion is valving. In 1976, two contracts were awarded by the Morgantown Energy Technology Center for prototype valve designs that stressed the use of new or unique materials and design concepts aimed at the future needs of the gasification industry. The Fairchild Stratos Division (FSD) designed a prototype valve using superalloys with preloaded ceramic seats. Consolidated Controls Corporation (CCC) designed a prototype valve using structural ceramics. The CCC valve experienced several failures during testing. This report presents the results of the Los Alamos National Laboratory's investigation into the existing designs and test data for lockhopper valves, with special emphasis on identification of existing and potential problems with the CCC valve design. 23 references, 17 figures, 3 tables.

25224 **(MTR—7814) Future energy supply/demand relationships and the effects of selected synfuels' subsidies.** Candela, B. (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1978. Contract AC01-76ET13049. 125p. (FE—2559-16). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011229.

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An evaluation of the effects that subsidies of synfuels may have on the total national energy bill and on imported fuels' costs and quantities is presented. The indications are that synfuels' subsidies may not significantly increase the total national bill for buying energy, but may have a major affect on the outlay for imported fuels. This appears to be particularly true if synliquids are subsidized. With or without subsidy, the total national bill does not appear to increase at such a rate as to jeopardize the national economy. The Gulf/SRI computerized model was selected for this Subtask 1 of a Mitre effort to assess ERDA's Major Facility Project Management Demonstration Program Plan. The work was completed in April 1977. This paper reflects recent reviews in preparation for the final task report. 28 references.

25225 **(MTR—7815) Ranking fossil energy demonstration candidates to meet selected national priorities.** Candela, B.; Alexander, R.; Bliss, C.; Rifkin, M. (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1978. Contract AC01-76ET13049. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011230.

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This report evaluates the FY-1978 Fossil Energy Demonstration Plants Program in its ability to serve the American Public in strategic and other non-commercial considerations. The result of the analysis suggests that hydrocarbon liquids derived from shale should be the first priority of the Program followed by low/intermediate Btu gas derived from coal for industrial or utility use. Coal-derived distillate or syncrude is ranked third. High Btu gas has low priority, inferring that the present Program to demonstrate one or more alternative approaches to produce high Btu gas may better be restructured toward the production of liquids. The direction of the industrial/utility Fuel Gas Program appears to be appropriate. 24 references.

25226 **(ORNL/TM—8551) Personnel and plant area monitoring at the University of Minnesota-Duluth gasifier.** Dreibelbis, W.G.; Van Hoesen, S.D.; Brandt, M.T.; McCutcheon, M.L. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010964.

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A comprehensive program of health and environmental studies was conducted of the small fixed bed gasifier at the University of Minnesota Duluth. A major area of investigation in this program was the occupational health experience of gasifier employees. Studies were directed at determining employee exposures to several stresses encountered at the gasifier; evaluating the impacts of plant operating parameters and controls on employee exposure; evaluating the toxicity associated with selected process products and by-products to which employees might be exposed; and evaluating the health experience of the employees through a medical surveillance program.

25227 **(PNL—4982) Photodegradation of mutagens in solvent-refined coal liquids.** Kalkwarf, D.R.; Stewart, D.L.; Pelroy, R.A.; Weimer, W.C. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010760.

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The purpose of this investigation was to evaluate any changes in the chemical composition and microbial mutagenicities of two representative solvent-refined coal (SRC) liquids as a function of exposure time to sunlight and air. This information was desired to assess potential health hazards arising from ground spills of these liquids during production, transport and use. Results of microbial mutagenicity assays using Salmonella typhimurium TA98, conducted after exposure, showed that the mutagenicities of both an SRC-II fuel oil blend and an SRC-I process solvent decreased continuously with exposure time to air and that the decrease was accelerated by simultaneous exposure to simulated sunlight. The liquids were exposed as thin layers supported on surfaces of glass, paper, clay or aluminum; but the type of support had little effect on the results. The contrast between these results and the reported increases of mutagenesis in organisms exposed simultaneously to coal liquids and near-ultraviolet light suggested that short-lived mutagenic intermediates, e.g., organic free radicals, were formed in the liquids during exposure to light. The highest activities of microbial mutagenicity in the SRC liquids were found in fractions rich in amino polycyclic aromatic hydrocarbons (amino PAH). After a 36-hour exposure of the fuel oil blend to air in the dark, the mutagenicity of its amine-rich fraction was reduced by 65%; whereas a 36-hour exposure in the light reduced the mutagenicity of this fraction by 92%. Similar rates of reduction in mutagenicity were achieved in exposures of the process solvent. The mutagenicities of other chemical fractions remained low during exposure.

25228 **(SAND—83-2533) Microflow reactor for studying catalyst deactivation.** Lynch, A.W.; Chapman, R.N.; Trudell, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011524.

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In multistage direct coal liquefaction processes, coal is first dissolved thermally and the resulting solubilized intermediates are then catalytically upgraded to distillate products. The catalyst is essential for the efficient utilization of hydrogen, and thus plays a key role in the production of clean liquid fuels from coal. Because the feed to the catalytic reactor usually contains metal and carbonaceous species that can deposit on the catalysts, catalyst deactivation, which results in a concomitant decrease in product quality with increasing time and temperature, is common to direct coal liquefaction processes. A microflow reactor has been designed and built for the purpose of evaluating catalyst deactivation under controlled laboratory conditions. The unit is capable of sustained operation at pressures to 500 psi and temperatures to 400°C. A specially designed pumping system meters coal liquids at very low flow rates (~ 5 g/hr). The microreactor requires less than 2 grams of catalyst, is easily assembled and can utilize coal liquid feeds specifically tailored to study deactivation. 6 references, 8 figures.

25229 **Coal liquefaction model studies: radical-initiated and phenol-inhibited decompostition of 1,3-diphenylpropane, dibenzyl ether, and phenethyl phenyl ether.** Gilbert, K.E. (Indiana Univ., Bloomington). *Journal of Organic Chemistry;* **49**: No. 1, 6-10(13 Jan 1984).

The thermal decompositions of 1,3-diphenylpropane (1), dibenzyl ether (2), and phenethyl phenyl ether (3) have been studied in the temperature range of 138-250 °C in the presence of various free-radical initiators. Thermodynamic calculations of the conversion of 1 to toluene and styrene indicate the reaction is unfavorable below 330°C, and 1 was found to be unreactive with di-tert-butyl peroxide (TPO) at 138 °C, di-tert-butyldiazene (TBD) at 200 °C, and 1,1,2,2-tetraphenylethane (TPE) at 250 °C. Reaction of 2 to toluene and benzaldehyde and of 3 to phenol and styrene were calculated to be energetically favorable at these temperatures. 2 reacted in the presence of TPO, TBD, and TPE to give toluene, benzaldehyde, and 1,2-diphenylethane in a free-radical chain process. 3 reacted in the presence of TBD and TPE to give phenol and styrene but did not react with TPO. Reaction of 2 can be inhibited with 2,6-di-tert-butyl-4-methylphenol. With TPO as the initiator the reaction was ~0.61 order in phenol, while with TBD as the initiator the reaction was ~1.1 order in phenol. The change in reaction order is due to changes in the rates of the various hydrogen-transfer reaction. The hindered phenol did not inhibit reaction of 2 at temperatures above 200 °C. The mechanisms of these reactions and the implications for coal liquification processes are discussed.

25230 **Characteristics of fluidization at high pressure.** Chitester, D.C.; Kornosky, R.M.; Fan, L.S.; Danko, J.P. (Pittsburgh Energy Tech. Center, PA). *Chemical Engineering Science;* **39**: No. 2, 253-261(1984).

Experiments were conducted to investigate fluidization fundamentals at pressures up to 6485 kPa using nitrogen as the fluidizing gas. The particles under study were coal, char and Ballotini. Both a three-dimensional bed (10.16-cm ID) and a two-dimensional bed (1.9 X 10.16 cm) were used in the experiments. The fundamentals of high pressure fluidization examined in this study include minimum fluidization velocity, bed voidage at minimum fluidization, bed expansion, and bubbling behavior. An empirical correlation was developed for determining minimum fluidization velocity. The effects of pressure upon bed voidage at minimum fluidization and expanded bed height were analyzed for several types of particles. High speed photographs were studied to describe bubbling behavior in a fluidized bed over a range of pressures.

25231 **Fossil energy materials research.** Bradley, R. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 117-119(Fal 1983).

Many processes that convert coal to liquid or gaseous fuels or that burn it directly expose the materials of construction to hostile environments, including high temperatures and pressures under highly corrosive, erosive conditions. The Oak Ridge National Laboratory's program for studying the behavior of materials in such environments is discussed. The objective of the research is to provide an understanding of the performance of existing materials in coal conversion and coal combustion systems and to develop new materials, where needed, for use in these systems.

25232 **Desulfurization of fuel gases in fluidized bed gasification and hot fuel gas cleanup systems.** Steinberg, M.; Farber, G.; Pruzansky, J.; Yoo, H.J.; McGauley, P. (to Dept. of Energy). US Patent Application 6-526,855. 26 Aug 1983. 23p. Contract AC02-76CH00016.

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A problem with the commercialization of fluidized bed gasification is that vast amounts of spent sorbent are generated if the sorbent is used on a once-through basis, especially if high sulfur coals are burned. The requirements of a sorbent for regenerative service in the FBG process are: (1) it must be capable of reducing the sulfur containing gas concentration of the FBG flue gas to within acceptable environmental standards; (2) it must not lose its reactivity on cyclic sulfidation and regeneration; (3) it must be capable of regeneration with elimination of substantially all of its sulfur content; (4) it must have good attrition resistance; and, (5) its cost must not be prohibitive. It has now been discovered that calcium silicate pellets, e.g., Portland cement type III pellets meet the criteria aforesaid. Calcium silicate removes COS and H_2S according to the reactions given to produce calcium sulfide silicate. The sulfur containing product can be regenerated using CO_2 as the regenerant. The sulfur dioxide can be conveniently reduced to sulfur with hydrogen or carbon for market or storage. The basic reactions in the process of this invention are the reactions with calcium silicate given in the patent. A convenient and inexpensive source of calcium silicate is Portland cement. Portland cement is a readily available, widely used construction meterial.

25233 **Process for removing sulfur from coal.** Aida, T.; Squires, T.G.; Venier, C.G. (to Dept. of Energy). US Patent Application 6-522,277. 11 Aug 1983. 15p. Contract W-7405-ENG-82.

A process is disclosed for the removal of divalent organic and inorganic sulfur compounds from coal and other carbonaceous material. A slurry of pulverized carbonaceous material is contacted with an electrophilic oxidant which selectively oxidizes the divalent organic and inorganic compounds to trivalent and tetravalent compounds. The carbonaceous material is then contacted with a molten caustic which dissolves the oxidized sulfur compounds away from the hydrocarbon matrix.

25234 **Time-resolved laser-induced breakdown spectrometry of aerosols.** Radziemski, L.J.; Loree, T.R.; Cremers, D.A.; Hoffman, N.M. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 8, 1246-1252(Jul 1983).

The repetitive breakdown spark from a focused laser beam was used to generate analytically useful emission spectra of aerosols in air. The apparatus is simple; a pulsed laser and optics, a spectrometer, and some method for time resolution of the spark light. Time resolution is essential because of the strong continuum emission at early times (<500 ns). High temperatures in the spark result in vaporization of small particles, dissociation of molecules, and excitation of atomic and ionic spectra. The plasma acts as if it were in local thermodynamic equilibrium, at least after 1 μs. Spectroscopic methods have been used to measure the time-resolved temperatures and electron densities. A simple one-dimensional hydrodynamic model predicts the temperature and diameter of the spark. Beryllium in atmospheric pressure air has been detected at 0.7 $\mu g/m^3$, which is 0.6 ng/g of air (RSD = 30%). Limits of detection have also been established for Na, P, As, and Hg in air. A calibration curve linear over 4 orders of magnitude has been developed for Na in air. In situ experiments have been performed on two experimental coal gasification systems, and real-time spectral information has been obtained in both cases. 37 references, 9 figures, 2 tables.

25235 **Silane-propane ignitor/burner.** Hill, R.W.; Skinner, D.F. Jr.; Thorsness, C.B. (to Dept. of Energy). US Patent Application 6-498,438. 26 May 1983. 13p. Contract W-7405-ENG-48.

A silane propane burner for an underground coal gasification process which is used to ignite the coal and to controllably retract the injection point by cutting the injection pipe. A narrow tube with a burner tip is positioned in the injection pipe through which an oxidant (oxygen or air) is flowed. A charge of silane followed by a supply of fuel, such as propane, is flowed through the tube. The silane spontaneously ignites on contact with oxygen and burns the propane fuel.

0105 By-products

REFER ALSO TO CITATION(S) 25217, 26545

25236 **(PNL-SA—11740) Rare earth element behavior in the development of energy resources.** Laul, J.C. (Pacific Northwest Lab., Richland, WA (USA)). 02 Apr 1984. Contract AC06-76RL01830. 13p. (CONF-840408—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010647.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

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The REE patterns in soil-soil extract-plant-coal-flyash are all identical, show a negative Eu anomaly, and follow a smooth function of the REE ionic radii. The patterns are similar to that observed in the secondary mineral apatite. Their enrichment factors in various liquefaction products and ash depositories of a coal fired power plant are nearly unity (Class 1). The REE do not chemically fractionate even in size fractions 25 μm-0.5 μm of flyash. Almost all (99%) of the REE are bound in an inorganic form in high temperature clay minerals. The remarkable similarity in REE patterns in a wide variety of matrices with REE content varying over six orders of magnitude demonstrates that the REE do not significantly fractionate during transformation from the geological-biological-geological chain over geological time scales.

0106 Properties

REFER ALSO TO CITATION(S) 25213, 25214, 25218, 25219, 25221, 25276, 26312, 26488

25237 **(DOE/ER/10982—3) Prediction of thermodynamic properties of coal derivatives. Progress report, September 1, 1983-August 31, 1984.** Donohue, M.D. (Johns Hopkins Univ., Baltimore, MD (USA)). May 1984. Contract AC02-81ER10982. 144p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84011245.

This report discusses theoretical and experimental work aimed at elucidating the effects of molecular structure and intermolecular forces on macroscopic thermodynamic properties. Theoretically, we have learned how to treat various molecular interactions so that quantitative predictions can be made for a variety of complex molecules and mixtures. These include Lennard-Jones interactions for non-polar molecules, anisotropic interactions for dipolar and quadrupolar molecules, and association effects (such as hydrogen bonding). In addition, a simplified version of the theory was developed which can be compared easily with other commonly used equations (namely, Peng-Robinson, Redlich-Kwong or van der Waals). The experimental portion of this program involves precise measurements of phase behavior for binary and ternary mixtures involving quadrupolar molecules. Experiments were conducted to determine the enhancement of solubility for 1-methyl naphthalene in super-critical carbon dioxide when toluene is added in small amounts. A new experimental apparatus is being built to study the vapor-liquid equilibria up to 4000 psia. 32 references, 13 figures, 5 tables.

25238 **(DOE/PC/40793—T9) Predictors of plasticity in bituminous coals. Final technical report.** Lloyd, W.G.; Reasoner, J.W.; Hower, J.C.; Yates, L.P.; Clark, C.P.; Davis, E.; Fitzpatrick, A.; Irefin, A.; Jiminez, A.; Jones, T.M. (Western Kentucky Univ., Bowling Green (USA). Ogden Coll. of Science, Technology and Health). 1 Feb 1984. Contract FG22-81PC40793. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84006651.

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A group of 40 hvb coals, mostly from western Kentucky fields, has been examined with regard to ASTM Gieseler plastometric properties. Twenty-nine of these coals have also been studied over a range of temperatures by isothermal Gieseler plastometry. Raw Gieseler data provide melting and coking slopes and readily calculable fluidity spans. Maximum fluidity by slope intersection is a more consistent measure than observed maximum fluidity. Isothermal slopes and maximum fluidities follow Arrhenius temperature dependencies, with activation energies related systematically to fluid properties. These freshly sampled coals are also characterized by chemical, physical and petrographic criteria, by quantitative solvent extractions, by pyrclysis gas chromatography, by Fourier Transform infrared analysis of coals and extraction residues, by the HPLC analysis of coal extracts, and by optical microscopy of coals and Gieseler semi-coke residues. Multiple linear regression analysis yields three-term expressions which estimate maximum fluidities (both ASTM and isothermal) with R values of .90 to .92. Slopes and critical temperatures are similarly predictable. Plastometer experiments with selected coals under superatmospheric pressures show both melting slopes and maximum fluidities to be sharply increased, the latter by one to three orders of magnitude. Some suggestions are offered to accommodate this new information into the general body of knowledge concerning the phenomenon of plasticity in mid-ranked coals. 81 references, 28 figures, 40 tables.

25239 **(DOE/PC/50790—T5) Role of preasphaltenes in coal conversion reactions. Second quarterly report, year two.** Hill, G.R.; Meuzelaar, H.L.C.; Futrell, J.H.; Harper, A.M. (Utah Univ., Salt Lake City (USA). Biomaterials Profiling Center). 1984. Contract FG22-82PC50790. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011432.

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The plans for the second year in the present contract called for application of analytical methods developed in the first year to the elucidation of the role of preasphaltenes in the coal conversion processes. As introduced and discussed in the last quarterly report, recent experiments have demonstrated the necessity of also studying the influence of weathering processes on coal structures and reactivity especially in regard to the production of preasphaltene-rich, short contact time (SCT) pyrolyzates. In this report we review and further develop some of the results presented in the last quarterly report as well as new information obtained in the second quarter. These results and their implications to initial coal structure and the role of preasphaltenes are discussed in respect to the following four tasks: (1) Study of the effects of laboratory weathering on the Free Swelling Index (FSI), sample weight, calorific value and ASTM proximate analysis on hvb Hiawatha coal. (2) Thermogravimetry (TG) and Derivative Thermogravimetry (DTG) of fresh and weathered hvb coal samples. (3) Pyrolysis mass spectrometry (Py-MS) analysis of fresh and weathered hvb coal samples and detailed examination of weathering effects. (4) Py-MS comparison of vacuum and pyridine extracts and SCT tubing bomb reactor products from fresh and weathered coals. 7 references, 11 figures, 2 tables.

25240 **(DOE/PC/50790—T6) Role of preasphaltenes in coal conversion reactions. First quarterly report, year two.** Hill, G.R.; Meuzelaar, H.L.C.; Futrell, J.H.; Harper, A.M. (Utah Univ., Salt Lake City (USA). Biomaterials Profiling Center). 1984. Contract FG22-82PC50790. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011441.

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The plans for the second year called for application of analytical methods developed in the first year to the elucidation of the role of preasphaltenes in coal conversion processes. Prior experiments with fresh and weathered coals, however, had provided strong indications for the existence of a marked influence of weathering processes on coal structure and reactivity in general and on the production of preasphaltene-rich, short-contact-time (SCT) pyrolyzates. In this report SCT pyrolysis experiments on coals of known weathering status are discussed and results presented. A review of the more recent literature on technologically relevant aspects of coal weathering is also included. 26 references, 8 figures.

25241 **(DOE/PC/50813—4) Effects of stresses on optical and chemical properties of coal. Technical progress report, May 1-July 31, 1983.** Ting, F.T.C. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 31 Jul 1983. Contract FG22-82PC50813. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010876.

The objectives of this research are to investigate the effects of natural stresses and laboratory induced stress conditions on the optical properties, carbonization behavior; and chemical properties of coal. The naturally and artificially strained coals will be examined for signs of any rotation of optical axis, any changes of carbonization behavior as observed under hot stage and other testing conditions; and chemical and structural changes. Experiments use a CGS Triaxial Load apparatus to deform coal under elevated temperature and pressure conditions are continued.

25242 **(DOE/PC/60799—2) Volatiles mass transport within particles of softened coal. Technical progress report, October 27, 1983-January 26, 1984.** Howard, J.B.; Oh, M.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1984. Contract FG22-83PC60799. 12p. (FE-MIT—60799-2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011138.

In order to obtain data on the molecular weight distribution of coal tar and pyridine extract of char, Gel Permeation Chromatography has been employed to separate the coal tar according to molecular size. The chromatographic system used was a Waters Associates ALC/GPC 201 Gel Permeation Chromatography system with 500 A and 100 A μ-styragel columns. Although the approximate molecular weight range for the columns has been determined by the manufacturer and there are standards of known molecular weight available, it is still necessary to calibrate the columns with coal tars since the calibration curve will be unique for the particular tars that are to be studied. The peak position method and the linear calibration method are both described and the results are compared. 1 reference, 3 tables, 3 figures.

25243 **(EPS—3-AP-82-6) Trace elements in Canadian coals.** Landheer, F.; Dibbs, H.; Labuda, J. (Environment Canada, Ottawa, Ontario. Environmental Protection Service). Aug 1982. 41p. Environment Canada, Environmental Protection Service, Ottawa, Ontario.

In this report, the concentrations of 42 trace elements in coal are given for 38 samples of coal obtained from coal fields across Canada. Neutron activation analysis was the principal analytical method used in the study: however, plasma emission spectrometry and flame atomic absorption spectrometry were also used. For some of the trace elements, the accuracy of the three analytical methods was checked by using two standard reference coals supplied by the United States National Bureau of Standards.

25244 **(EUR—8381-DE) Assessment of coke strength after reaction with carbon dioxide (Report on ECSC contract 7220/EB/311).** Orywal, F.; Pollert, G.; Arendt, P. (Commission of the European Communities, Luxembourg). 1983. 34p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The scaling-up of investigations of coke strength after gasification with CO_2 is described. Early work on orientation tests at 1100 degrees C in a hot drum of heat-resistant steel showed that the simultaneous study of thermal, chemical and mechanical stresses was extremely complex and so modified test conditions simulating a blast furnace were employed. The developments in testing are described.

25245 **(PNL-SA—11331) Stability studies on the chemical and biological activity of coal-derived liquids.** Wright, C.W.; Daly, C.S.; Weimer, W.C. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 16p. (CONF-8310179—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010702.

From 8. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1983).

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After four years of storage, no chemical composition or mutagenicity changes occurred in the 17 SRC materials stored in the repository under controlled conditions. The integrity of the samples has been maintained at 4°C, in inert containers, in the dark, under a nitrogen atmosphere. After one year of storage of SRC II fuel oil blend (FOB) samples at room temperatures under various parameters of ambient light, cover atmosphere, and dilution, no gross chemical composition changes occurred except when diluted in methylene chloride, in the light, under an air atmosphere. Under these conditions, hydroxylated PAH such as the cresols and indanol decomposed. Also, hydrogenated PAH such as unsubstituted and alkylated indans and tetralins decomposed. Mutagenicity of the FOB was significantly decreased or eliminated when stored both diluted and undiluted at room temperature for one year under an air atmosphere in ambient light. Mutagenicity decreased when no gross chemical compositional changes were noted due to trace component degradation, probably primary aromatic amines. After 32 weeks of storage at 60°C, hydroxylated PAH such as o-cresol and indanol degraded in the FOB. Hydrogenated PAH such as alkylated indans also showed a significant decrease. Mutagenicity was completed eliminated under these harsh storage conditions. A more complete discussion of effects of storage under increased temperature on the nitrogen-containing polycyclic aromatic compounds present in the FOB is forthcoming. 13 references, 5 tables.

25246 **Which coal at what cost.** Corio, M.R.; Condren, A.E. (Applied Economic Research Co., New York, NY). *Public Utilities Fortnightly;* **113**: No. 6, 32-36(15 Mar 1984).

The various components of steam coal (ash, sulfur, Btu, and moisture content) significantly affect boiler performance. Decisions regarding the purchase of blends of coal which vary from that for which a unit is designed will result in changes in availability and heat rates for that unit. This article examines potential performance losses attributable to coal quality. Research conducted by the authors reveals specific effects of burning alternate grades of coal and suggests the means of translating unit performance into cost, enabling the coal purchaser to make a more accurate evaluation of that fuel. 2 references, 1 table.

25247 **Effect of solvent swelling on diffusion rates in bituminous coal.** Larsen, J.W.; Lee, D. (Department of Chemistry, University of Tennessee, Knoxville, TN). *Fuel;* **62**: No. 11, 1352-1354(Nov 1983).

The Diels-Alder reaction of maleic anhydride with Illinois No. 6 and Bruceton coals is much slower than with anthracene and depends on the square root of time, establishing that the rate of this reaction is diffusion controlled. The rate of this reaction was measured for these two coals swollen with a number of different solvents. The rate of reaction and thus the rate of diffusion of maleic anhydride into the coals was independent of the degree of swelling of the coals.

25248 **Photothermal method of determining calorific properties of coal.** Amer, N.M. (to Dept. of Energy). US Patent Application 6-495,205. 16 May 1983. 24p. Contract W-7405-ENG-48.

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Predetermined amounts of heat are generated within a coal sample by directing pump light pulses of predetermined energy content into a small surface region of the sample. A beam of probe light is directed along the sample surface and deflection of the probe beam from thermally induced changes of index of refraction in the fluid medium adjacent the heated region are detected. Deflection amplitude and the phase lag of the deflection, relative to the initiating pump light pulse, are indicative of the calorific value and the porosity of the sample. The method provides rapid, accurate and nondestructive analysis of the heat producing capabilities of coal samples. In the preferred form, sequences of pump light pulses of increasing durations are directed into the sample at each of a series of minute regions situated along a raster scan path enabling detailed analysis of variations of thermal properties at different areas of the sample and at different depths.

25249 **Determination of alkyl anilines and alkyl pyridines in solvent refined coal distillates and aqueous extracts by gas chromatography/mass spectrometry.** Felice, L.J. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **55**: No. 6, 869-872(May 1983). Contract AC06-76RL01830.

Derivation with acetic anhydride in aqueous media coupled with capillary gas chromatography mass spectrometry was used to distinguish alkyl anilines from alkyl pyridines. By use of this approach aniline, C-1 anilines, and C-2 anilines, as well as lesser quantities of C-2 pyridines and C-3 pyridines, were positively identified in a solvent refined coal (SRC)-II blended distillate and in an aqueous extract of the distillate. The extraction procedure and acetylation conditions employed were examined in detail and found suitable for quantitative analysis when combined with capillary gas chromatography. The SRC-II blended distillate contained 8200-9025 μg/mL anilines and 1335 $^{+}$g/mL pyridines. Distilled water equilibrated with the distillate (1:100, SRC-II:H_2O) contained 65.9-78.9 $^{+}$g/mL anilines and 5.6 $^{+}$g/mL pyridines. 3 figures, 1 table.

0108 Waste Management

REFER ALSO TO CITATION(S) 26990, 27077

25250 **(CANMET—81-9E) Mineral waste resource of Canada. Report No. 5. Mining wastes in the Prairie Provinces.** Collings, R.K. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jul 1981. 21p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Coal mining wastes from Coleman Collieries Ltd. at Coleman, Cardinal River Coals Ltd. at Luscar, and McIntyre Mines Ltd at Grande Cache, Alberta are included in this survey.

25251 **(DOE/FE/60181—47) Field study of a combined NH_3-SO_3 conditioning system on a cold-side fly ash precipitator at a coal-fired power plant.** Dahlin, R.S.; Marchant, G.H. Jr.; Gooch, J.P.; Bickelhaupt, R.E.; Sears, D.R.; Altman, R.F. (Southern Research Inst., Birmingham, AL (USA); Bickelhaupt Associates, Inc., Carbondale, IL (USA); North Dakota Univ., Grand Forks (USA). Energy Research Center; Electric Power Research Inst., Chattanooga, TN (USA)). 1984. Contract FC21-83FE60181. 16p. (CONF-840612—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010472.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

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This paper describes the results of a field study of a combined NH_3-SO_3 conditioning system used to improve the performance of a cold-side electrostatic precipitator at a large coal-fired power plant. The combined NH_3-SO_3 conditioning system was placed into continuous service after numerous tests by plant personnel showed that the combined NH_3-SO_3 system was more effective than the use of either NH_3 or SO_3 alone. In the tests by plant personnel, the effectiveness of various injection locations and injection rates of one or both agents was judged on the ability to maintain an acceptable stack opacity. Based on the results of these tests, the plant management selected a combined conditioning system in which NH_3 is injected between the air heater and the precipitator at a rate of 5 ppM, and SO_3 is injected ahead of the air heater at a rate of 9 ppM. This was in addition to 5 ppM of SO_3 that is produced naturally in the pulverized coal-fired boiler. In most applications of flue gas conditioning, the SO_3 is injected downstream of the air heater; however, it is believed that injection ahead of the air heater, as was done at this plant, may result in a more uniform distribution of the SO_3 in the flue gas and more effective utilization of the SO_3. The combined NH_3-SO_3 conditioning process appears to be a feasible and useful method of maintaining acceptable performance levels in a cold-side electrostatic precipitator. Additional work

is needed to fully understand the mechanisms by which the NH_3 and SO_3 act together to condition the fly ash and affect precipitator performance. A more thorough investigation of the NH_3-SO_3 conditioning process is justified in view of the potential for improving ESP performance, or reducing the size of a new ESP. 11 references, 6 figures, 2 tables.

25252 (LBL—13500, pp 1.38-1.40) **Kinetic study of reactions involving ferrous nitrosyl complexes.** Littlejohn, D.; Lynn, S.; Chang, S.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25253 (LBL—13500, pp 1.41-1.43) **Thermodynamics and kinetics of the coordination of NO to Fe(II)NTA in aqueous solutions.** Lin, N.H.; Littlejohn, D.; Lynn, S.; Chang, S.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25254 (LBL—13500, pp 1.43-1.47) **Wet flue gas simulataneous desulfurization and denitrification system.** Chang, S.G.; Lynn, S.; Littlejohn, D.; Lin, N.H. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25255 **Coal gasification waste disposal: the impact of regulation.** Chiu, S.Y.; Barisas, S.; Fradkin, L.; Surles, T. (Argonne National Lab., IL). *Environmental Progress;* **2**: No. 1, 1-7(Feb 1983).

The study reported in this paper was designed to assess the impact of the Resource Conservation and Recovery Act (RCRA) on high-Btu coal gasification. The study has three objectives: first, to characterize solid wastes from synfuel technologies, by evaluating data on their chemical composition and biological characteristics; second, to review RCRA regulations, with emphasis on solid-waste treatment and disposal requirements specified under the Act; third, to assess the costs of disposal of hazardous and nonhazardous wastes generated from selected commercial-scale high-Btu gasification facilities. 15 references, 3 tables.

25256 **Influence of thiophene on the selective reduction of NO by NH_3.** Lucas, D.; Brown, N.J. (Lawrence Berkeley Lab., CA). *Combustion and Flame;* **49**: 283-288(1983). Contract W-7405-ENG-48.

The selective reduction of NO by NH_3 addition has been studied in a lean-burning oil-fired laboratory combustion tunnel with pyridine and thiophene added to the fuel oil. Two distinct but interrelated effects were observed. The conversion of a fixed amount of fuel nitrogen to NO in the flame increased as the thiophene concentration increased. In the postcombustion gases, there was a shift in the temperature dependence of the reduction process when the sulfur combustion products were present. The extent of the NO reduction was not significantly altered, but the optimal temperature for reduction shifted to higher values as the thiophene concentration increased. 4 figures, 1 table.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 25226, 25256, 25292, 27060, 27209

25257 **(BMFT-FB-T—83-233) Drawing up the mathematical basis for the advanced calculation of ground movement elements under the conditions of the coal deposits in the Saar district.** Bauer, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 72p. (In German). NTIS (US Sales Only), PC A04 MF/A01. Order Number DE84750935.

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Introduction and application of the EDP-Model is drawn up in part 1 (1974-1977) of this R and D Program. By means of this model the subsidences due to coal mining in the Saar-District will be calculated. Further development of the EDP-Model is described with regard to displacement, changes in length and effects of seam inclination. Determination of suitable parameters for the model. Evaluation and plotting by computer. Application of mathematical model - development at the Technical University of Clausthal - with arbitrary parameters determines all ground movements caused by mining. By means of the known parameters, all movements of single points, points within a lineage and also a pattern can be determined and plotted. On the other hand the parameters needed can be determined and correlated by observation points. This method provides the prediction of ground movements immediately and more precisely. The result will be a better design of mining layout. Coal losses will be minimized. Using fitted parameters the method is universally practicable.

25258 **(ORNL/TM—8951) H-Coal environmental and health process studies: process description and sampling strategy.** Klein, J.A.; Roddy, J.W. (Oak Ridge National Lab., TN (USA)). Jun 1984. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011856.

As part of a jointly funded program between industry and the U.S. Department of Energy, Ashland Synthetic Fuels, Inc. operated the H-Coal coal liquefaction pilot plant at Catlettsburg, Kentucky. During its operation, the plant was the focus of a health and environmental study program conducted by the Oak Ridge National Laboratory and sponsored by the Office of Health and Environmental Research of the Department of Energy. This report on the sample strategy and acquisition provides a general process description, including a brief history of the operation of the pilot plant. A comparison of samples with the H-coal Trenton Process Development Unit and the Breckenridge commercial design is also included.

25259 **Coal liquefaction.** Cochran, H.D. *Oak Ridge National Laboratory Review (United States);* **13**: No. 1, 38-43(1980).

An overview of coal liquefaction is presented through history, status and economic prospects of three broad classes of coal liquefaction processes, i.e., direct, pyrolysis, and indirect.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 25265

0120 Mining

REFER ALSO TO CITATION(S) 25293, 25294, 26767

25260 **(ACIRL-PR—83-8) Coal mine ventilation.** Ralph, A.M.; Nixon, T.R.; Deakin, J.J. (Australian Coal Industry Research Labs. Ltd., North Ryde). Oct 1983. 51p. Australian Coal Industry Research Labs. Ltd., North Ryde.

The report discusses the ventilation systems currently employed by ACIRL. The techniques and procedures used in the analysis of a ventilation system are discussed. Particular emphasis is placed upon the nature of airflow through mine stoppings, calculation of regulator areas from pressure and air quantity data and the utilisation of a ventilation database for mine planning. The MINVENT system of computer programs, which is used to analyse the ventilation systems, is described and the appropriate instructions for the use of this program are documented. MINVENT incorporates a number of graphical facilities which provide for ease of interpretation of results. For example, the results of a ventilation analysis can be represented in schematic form which can be superimposed on a mine plan. (10 refs.)

25261 **(ACIRL-PR—83-9) Stability of chain pillars and gate roads at South Bulli 'B' mine longwalls.** Schaller, S. (Australian Coal Industry Research Labs. Ltd., North Ryde). Oct 1983. 80p. Australian Coal Industry Research Labs. Ltd., North Ryde.

The report describes the current ACIRL research project on roof control in the longwall roadways and stability of the chain pillars at South Bulli Colliery. An analysis of the results of monitoring in several longwalls has established gate road and pillar design criteria with a minimum of coal sterilised underground. Computer simulation of the longwall mining conditions has indicated that wider chain pillars would improve tailgate stability to a greater extent than pump packing. The colliery therefore decided to experiment with various chain pillar widths and longer longwall faces to maintain the coal recovery ratio. Convergence, stress and deformation in surrounding strata have been monitored and analysed, and this report presents the results. (5 refs.)

25262 **(BMFT-FB-T—83-234) Theoretical investigations for an underground longwall mining method (working to the strike) for steeply dipping coal seams with cemented rockfill.** Helms, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 414p. (In German). NTIS (US Sales Only), PC A18 MF/A01. Order Number DE84750934.

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Coal production from steeply dipping seams in Germany has decreased in the last years, because there are no productive mining methods for these deposits. Aim of the research project was the conception and investigation of a longwall mining method with cemented rockfill for backfilling. Technical equipment and operation of this mining system have been investigated theoretically and experimental tests have been made. The longwall face equipment, consisting fo a shearer, a guideline for this machine, support units and airbags for support of the fresh backfill, have been projected. Stability of the roof support units and pressure to the stowing screen have been calculated. The geomechanical aspects of backfill within longwall mining operation have been investigated by finite-element-method. Requirements to the cemented rockfill for stability of the backfill wall have been determined. Compression behaviour, compression strength and shear strength of washery dirt with and without binding agents have been tested in the laboratory and calculations for optimum rock-cement-mixtures have been worked out. Operation variants for the mining system have been compared and calculations for investment and costs have been undertaken. Theoretically production per day up to 1500 tons (metric) and output per manshift in the face area up to 40 tons are possible to attain. Drifting and arrangements of the gate roads on the sublevels have been investigated.

25263 **(BMFT-FB-T—83-258) Minimizing underground and surface subsidence by rapidly setting stowage.** Stams, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 135p. (In German). NTIS (US Sales Only), PC A07 MF/A01. Order Number DE84750939.

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Long-wall mining equipped with self-advancing roof support and pneumatic stowing has not yet been applied to gradients of more than 40 gon. After pilot tests in the Erin colliery, two faces have been mined in the Roettgersbank seam, using an electro-mechanical double drum shearer, a double chain face conveyor, a 3-leg chock-shield and a pneumatic stower together with different devices for adding binders to the stowing material. The winning and support systems worked successfully. The admixture of binders to the stowing material could not satisfy due to continuously changing pressure conditions in the stowing pipeline, the short stowing intervals and particularly due to remote control problems. The subsidence measurements gave evidence, that mine workings in short distance of the mining area as gave evidence, that mine workings in short distance of the mining area as well as surface structures are less influenced by pneumatic stowing as compared to caving.

25264 **(BMFT-FB-T—83-262) Improvement of ROM coal quality.** Klee, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 93p. (In German). NTIS (US Sales Only), PC A05 MF/A01. Order Number DE84750936.

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There are no recent investigations on hand concerning inadvertent and undesirable size degradation to which coal is subjected underground. Investigations were initiated by the incessant size degradation of the fraction over 10 mm. Investigations were based on ROM coal samples obtained and analyzed in accordance with standard regulations. The target concept of expressing by some mechanical equivalent the load exerted on ROM coals at the underground in order to thus eliminate raw material-induced factors cannot be implemented for the time being. Progressive hardening of the coal was not observed. Size degradation is a linear function of the intensity of mechanical load. Some 49% of total size degradation takes place during coal-getting, against approx. 51% during underground transport. Considerable degradation is brought about by chain conveyors and spiral chutes.

25265 **(DOE/MC/19404—T16) Measurement of dynamic reservoir conditions. Fourth project status report, July 1-September 30, 1983.** (United States Steel Corp., Monroeville, PA). 28 Mar 1984. Contract AC21-82MC19404. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009300.

Project reports are presented for Task IV.6 perforation of the Mary Lee seam, Task IV.7 natural fracture study of the Oak Grove Field, and for Task V monitoring. Summary status assessment and forecast: The overall project is healthy from a cost and technical standpoint. Because of changes in mining projections at Oak Grove, interception of the bottom of borehole DHM-7 will be delayed indefinitely. Therefore, Task 3.IV.5, Borehole Stimulation, will be delayed until spring of 1984 to permit further testing of the borehole and gathering baseline production data from the unstimulated borehole.

25266 **(DOE/PC/60053—T2) Socio-economic, subsidence, transportation, and legal ramifications of potential liquefaction plant sitings. Task B. Prediction of subsidence potential over abandoned mine land. Quarterly report, October 1-December 31, 1983.** Peng, S.S.; Su, W.H. (West Virginia Univ., Morgantown (USA). Dept. of Mining Engineering). 1983. Contract FG22-83PC60053. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010467.

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Subsidence over active longwall mines, which occurs concurrently with mining or is completed within a few days following coal extraction has been studied extensively over the past decade. On the other hand, subsidence over abandoned coal mines is difficult to predict and may take place decades after mining has ceased. Two types of delayed subsidence are normally observed: troughs, which are shallow depressions, and sinks, which are steep-sided pits. Both types of delayed subsidence may cause damages to surface structures. Most of the abandoned coal mines in the Appalachian coal field were mined by the room-and-pillar method. These mines generally are very shallow and are very irregular with unsupported roof spans of varying widths. The approach adopted in this research for predicting the subsidence potential over abandoned coal mines focuses on the development of a mathematical model, essentially a finite element model capable of modeling the viscoelastic behavior of rocks and coal. The simulation of the viscoelastic behavior of rocks and coal is needed for predicting the delayed subsidence. The assessment of subsidence potential over abandoned mine land is currently being conducted on two sites. Site investigation is aimed at obtaining the following data: surface topography, information on the overburden, local geology and ground crater hydrology, the physical and mechanical properties of the rock strats, past subsidence damages, if any, in the area, and the old mine maps. Most of the physical and mechanical properties of the rock strata will be obtained, if possible, from previous tests performed on similar types of rocks. Information on the viscoelastic behavior of the rocks and coals, however, are very scarce.

25267 **(EUR—8360-EN) Prediction of strata stability from instrumentation and modelling data (Report on ECSC contract 7220-AC/811).** (Commission of the European Communities, Luxembourg). 1983. 193p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The report describes research undertaken with the object of developing the understanding of strata deformation around mine excavations. Initial effort was directed as described in part 1 to establishing the necessary research facilities. In particular, existing borehole instrumentation systems were improved, and a computer-based

system for processing and storing investigation results was developed. In addition, the performance of a finite difference mathematical model was enhanced, so continuing the development of a tool for predicting strata deformation. The research facilities were applied in detailed investigations as described in part 2. Results obtained from these investigations were subsequently used to examine the accuracy of theory predicting the extent of yield zones, and to assist the validity of the finite difference model. Conclusions and recommendations are presented for each aspect of the research work.

25268 **(EUR—8431-FR) Forecasting of firedamp release and means of combating firedamp. Summary report of INIEX research (Report on ECSC contract 7220-AC/205).** Boxho, J. (Commission of the European Communities, Luxembourg). 1982. 59p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Formulae are presented for forecasting the release of firedamp from mine workings, and the assumptions on which they are based are explained. Consideration is given to the influence of seam faults on firedamp release and to variations in releases from wall and roof in the same seam. Ventilation problems in the fire-damp zones, especially at the head of narrow workings are discussed. Catchment by drilling is assessed with regard to the length of the borehole, distance between boreholes, applied pressure reduction, tubing, and the life-span of a bore. Catchment in closed mines is also considered, with details of the amounts trapped, applied pressure reduction, and the life-span of the catchment. Examples from actual mine workings are given.

25269 **(EUR—8827-EN) Mine roadway floor stabilisation (Report on ECSC contract 7220-AE/810).** (Commission of the European Communities, Luxembourg). 1983. 64p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

This report discusses the extension of the research contract awarded to MRDE to support its mine roadway floor stabilisation project. The work on the project was divided between MRDE and High Moor Colliery. At the Colliery, substantial lengths of anhydrite based mixes were laid underground for evaluation as a running surface for free-steered rubber-tyred vehicles. It also provided underground operational experience for new equipment. At MRDE, the programme of work covered technical assistance to the Colliery, the modification of and trials of new roadlaying equipment.

25270 **(NP—4770239) Importance of services in mining as exemplified by special mining companies.** Wollers, K. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Bergbauwissenschaften). 1983. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770239.

Portions are illegible in microfiche products; Paper presented at the meeting of Technische Univ. Berlin, Inst. fuer Bergbauwissenschaften, 13 Jun 1983.

Now as before the German special mining companies represent a considerable factor in the provision of advance services - particularly for German coal mining. On the basis of their significant technical developments a degree of mechanization and rationalization has been achieved which enables the companies to offer their services at optimal conditions and to make them available. For this reason the mining industries should, especially in times of emergency, permanently utilize this remarkable potential with a view to economic production.

25271 **Coalbed methane potential of "J" group coals in the vicinity of Tuscaloosa, Alabama.** Tuscaloosa, AL; University of Alabama (1983). 71p.

A study was undertaken to gather data on the development potential of deep seam methane beneath the University of Alabama campus and, in a general way, the potential in the surrounding area of the Warrior coal basin. An existing corehole was deepened to 4000 feet, coal was recovered and tested for gas content, and the measured volumes indicated that insufficient methane was present to warrant development under current market and price conditions. This report describes the methods, results, and conclusions. Included is an appendix which describes in detail the lithologic log of the drill core. 18 figures, 5 tables.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 25216

25272 (ANL/CNSV-TM—127, pp 81-86) **Peat fuel enterprises in America.** Massengill, B. (California Pellet Mill Co., Minneapolis, MN). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

Raw materials for densified fuel are almost unlimited if we look at all the agricultural residues, roadside and median grasses and products from unused state and federal lands. For the purposes of this discussion we only talk about those raw materials already being pelleted in the five state area of North and South Dakota, Minnesota, Wisconsin, and Michigan. These are wood waste, peat, sunflower hulls and straw. The author concludes that peat is very valuable because of two unique features it has when densified. In sod or pellet form, peat will dewater itself if it is stored under aeration or in open areas. Secondly, peat is one of the easiest materials to densify ever encountered. It can even be pelleted at 50% moisture. Those characteristics caused me to examine the possibility of blending wet peat (50% moisture) to some of the other fiber fuels that gave us much trouble in the pelleting process. Although tests are still underway, it is evident that peat will greatly enhance the pelleting characteristics of such fuels as wood, sunflower hulls, cotton waste, straw and even coal dust.

25273 **(CONF-840577—5) Active ultrasonic cross-correlation flowmeters for mixed-phase pipe flows.** Sheen, S.H.; Raptis, A.C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006449.

From 30. international instrumentation symposium; Denver, CO, USA (7 May 1984).

This paper describes two ultrasonic flowmeters which employ the active cross-correlation technique and uses a simple clamp-on transducer arrangement. The flowmeter for solid/liquid flows was tested over a wide range of coal concentration in water and oil. The measured velocity based on the peak position of the cross-correlation function is consistently higher by about 15% than the average velocity measured by flow diversion. The origin of the difference results mainly from the flow velocity profiles and the transit-time probability distribution. The flowmeter that can measure particle velocity in a solid/gas flow requires acoustic decoupling arrangement between two sensing stations. The measured velocity is mainly associated with the particles near the wall. Performance of both flowmeters is presented.

25274 **(CONF-840612—6) Coal cleaning as an acid rain mitigation strategy: an in-depth examination.** Garvey, D.B.; Doctor, R.D.; Anderson, J.L.; Livengood, C.D.; Farber, P.S. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010527.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

This study had as its primary focus the question of what SO_2 reductions could be obtained in the Midwest by applying extensive physical coal cleaning to fuels being burned by major power plants. The issue of concern is strategies for achieving the level of SO_2 emission reductions (typically at least 50% from 1980 levels) proposed in acid rain legislation. The washabilities of the primary coals delivered to 20 plants in Illinois, Indiana and Ohio were examined in detail. Annual SO_2 emissions were calculated for each plant under 1980 operating conditions (capacity factor, heat rate, etc.) assuming 1980 fuel use (a combination of coals) and assuming only the major coal source was used (both raw ROM and cleaned to 80% weight recovery). Cleaning ROM coal could result in potential reductions for individual plants from 10 to 50%. In comparison to 1980 emissions, however, these reductions ranged from 4 to 52%. The results of this study show that several specific power

plants could achieve a 50% reduction in annual SO_2 emissions by switching to complete reliance on the main coal source and physically cleaning that coal. Thus, coal cleaning may be a cost-effective SO_2 control strategy for individual plants, but its usefulness as a mandatory acid rain mitigation strategy is limited. PCC has other advantages, however, such as: reducing coal-transportation requirements (reduced secondary emissions and public safety hazards); producing a more uniform fuel; improving boiler efficiency by reducing slagging on boiler tubes; reducing load factors for ash-collection and handling systems; and improving overall plant availability. In addition, PCC may improve the performance and reduce the costs of operating an FGD system for SO_2 removal.

25275 **(DOE/PC/30234—T3) Microbubble flotation of fine coal. Final report.** Yoon, R.H. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mining and Minerals Engineering). Mar 1984. Contract FG22-80PC30234. 195p. NTIS, PC A09/MF A01; GPO Dep. Order Number DE84009555.

Fine coal flotation has been a longstanding problem in industry. Coal particles below approximately 38 microns in diameter are difficult to float, and the process consumes large amounts of reagents. Hydrodynamic analyses have shown, however, that the use of air bubbles smaller than those that are generated in conventional flotation machines (0.2 to 3 mm diameter) can improve the flotation rate and, hence, the coal recovery. Theoretically, a tenfold reduction in average bubble size should result in a thousandfold increase in the flotation rate constant at a given gas flow rate. Therefore, work has been done to use microbubbles less than 100 microns in diameter for the flotation of fine coal particles. Seven different U.S. coal samples have been tested in the present work. The feed size varies from -100 mesh to -500 mesh. Flotation kinetics tests have been conducted on some of these coal samples as a function of bubble size at a constant gas flow rate. The results show a drastic improvement in flotation rate with the use of microbubbles, which may account for the improved recoveries obtained with the microbubble flotation technique. In addition, test results obtained with ultrafine coal samples (-20 microns) indicate that the microbubble flotation process is more selective than conventional flotation. This improved selectivity has been explained tentatively by the increased bubble loading and the reduced turbulence around the microbubbles. Various techniques have been employed to further enhance the selectivity of the process by minimizing the ash entrapment problem. To better understand the mechanisms of microbubble flotation, basic information regarding surface tension, contact angle, viscosity, streaming currents of microbubbles, electrophoretic mobilities of coal and mineral matter, and stability of microbubble suspensions has been obtained. 50 references, 42 figures, 9 tables.

25276 **(DOE/PC/50797—T5) Novel analytical approaches to coal beneficiation. Quarterly report.** Griffiths, P.R. (California Univ., Riverside (USA)). 17 Apr 1984. Contract FG22-82PC50797. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010469.

Work has been concerned with the development of numerical methods of deriving the concentration of functional groups in coals from the areas of strongly overlapping bands in their infrared spectra. It has been shown both by us and by others that overlapping bands in coal spectra may be resolved by Fourier self-deconvolution. We have assigned many of these features to specific functional groups. An example of the power of Fourier self-deconvolution (FSD) to resolve absorption features caused by the aliphatic C-H stretching modes of a medium volatile bituminous coal is shown in Figure 1. Spectra which have been subjected to FSD should be more useful for quantitative analysis than derivative spectra since the areas of each band are identical before and after deconvolution. Unless all spectral features are completely resolved, however, the effect of overlap by neighboring bands still precludes the accurate determination of each absorbing species by a simple measurement of band intensities. We have therefore attempted to fit spectra which had been subjected to FSD using a least-squares curve-fitting routine, and to determine the areas of each peak in the deconvolved spectrum from the parameters giving the least-squares best fit. Previously we had attempted to curve-fit the spectra of coals in several spectral regions using techniques which have been described by Painter et al, but we found that a given spectrum could be fit to approximately the same degree of accuracy by many different combinations of bands. Through the application of FSD, not only could the number of bands included in the curve-fitting program be limited to those observable in the deconvolved spectrum, but the initial estimate of their absorption frequencies could also be obtained from this spectrum.

25277 **Physico-chemical fracturing and cleaning of coal.** Sapienza, R.S.; Slegeir, W.A.R. (to Dept. of Energy). US Patent Application 6-538,006. 30 Sep 1983. 13p. Contract AC02-76CH00016.

This invention relates to a method of producing a crushable coal and reducing the metallic values in coal represented by Si, Al, Ca, Na, K, and Mg, which comprises contacting a coal/water mix in a weight ratio of from about 4:1 to 1:6 in the presence of CO_2 at pressures of about 100 to 1400 psi and a minimum temperature of about 15°C for a period of about one or more hours to produce a treated coal/water mix. In the process the treated coal/water mix has reduced values for Ca and Mg of up to 78% over the starting mix and the advantageous CO_2 concentration is in the range of about 3 to 30 g/L. Below 5 g/L CO_2 only small effects are observed and above 30 g/L no further special advantages are achieved. The coal/water ratios in the range 1:2 to 2:1 are particularly desirable and such ratios are compatible with coal water slurry applications.

25278 **Microcomputer simulation of coal preparation plants.** Chaves, M.M.; Gottfried, B.S. (Dept of Industrial Eng. Univ. of Pittsburgh, Pittsburgh, PA). pp 173-176 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

For the past several years the U.S. Department of Energy has sponsored the development of a computer simulation program that will predict the performance of coal preparation plants under a variety of different operating conditions. Recently a study was undertaken to transfer the simulation logic from the large scale mainframe environment to a small inexpensive microcomputer operating in a highly interactive "user friendly" environment. This paper describes a program that was written for the APPLE II Plus microcomputer which accomplishes these objectives. The program prompts the user for information in such a manner that it can be used by persons other than computer specialists. This makes the program directly accessible to plant managers, designers and operating engineers.

25279 **Interfacing comminution and classification models with a general flowsheet simulator.** Klima, M.S.; Luckie, P.T. (Mineral Processing Section, The Pennsylvania State University, University Park, Pennsylvania). pp 200-207 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

Interfacing new or improved unit operations SUBMODULES with the EXECUTIVE of a macro analysis simulator usually requires modification of the input data. For example, particle processing SUBMODULES that are sufficiently general in nature to provide useful predictions require input data for rather narrow size fractions. Such data is not always available for the EXECUTIVE and must therefore be generated by the SUBMODULE. A successful interface to allow incorporation of a new SUBMODULE for comminution and one for classification in a general stream state flowsheet simulator is presented. The general nature of the SUBMODULES, as well as the logic of expanding and contracting the required data input is discussed.

25280 **The Department of Energy's coal washer performance computer program.** Wizzard, J.T.; Gottfried, B.S.; Killmeyer, R.P. (Coal Preparation Branch, Pittsburgh Energy Technology Center, U.S. Department of Energy, Pittsburgh, PA). pp 215-221 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

The Coal Preparation Branch of the Pittsburgh Energy Technology Center has developed a computer program to calculate the performance characteristics of coal washing devices. This program uses specific gravity analyses of the clean coal and refuse streams as input, and generates dependent and independent performance criteria for the washer. Partition curves are internally represented in a functional form by a Weibull function. Performance criteria generated by this computer program are compared to manually calculated performance criteria for air tables, Dynawhirlpools, Baum jigs, hydrocyclones, and dense medium cyclones. The comparisons show that the computer program gives results in close agreement with the handcalculated values while greatly reducing the amount of time involved in performing the analyses.

25281 **A simulator for dewatering of coal fines.** Tierney, J.W.; Gottfried, B.S.; Zhao, G.Q. (School of Engineering Univ. of Pittsburgh, Pittsburgh, PA). pp 230-236 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

Equations for predicting the performance of vacuum filters and centrifuges used for coal dewatering are presented. These equations are the basis for a dewatering module which has recently been added to the Coal Preparation Plant Simulator developed at the University of Pittsburgh under the sponsorship of the Department of Energy. The module provides for mechanical degradation in the centrifuge; loss of fines to centrate or filtrate; changes in size and gravity distribution; changes in ash and sulfur content; as well as final moisture content of the dewatered product. Inputs to the module are the flow rate of the coal to be dewatered, a washability analysis of the coal, and parameters describing the operation of the vacuum filter or centrifuge. Typical results obtained using the module are presented. There are adjustable parameters which can be varied to match plant operation or experimental data if desired.

0140 Combustion

REFER ALSO TO CITATION(S) 25197, 25222, 25246, 25256, 25625, 26756

25282 (ANL—83-55, pp 63-77) **Utilization of coal.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

Research in support of fluidized-bed combustion included: enhancement of limestone utilization, flue gas cleaning for PFBC, and modification of the test facility. Other coal programs include investigations of two- and three-phase flows and development and testing of catalysts for indirect liquefaction of coal.

25283 **(DOE/ET/12240—T1) Coal burning rate studies. Final report, September 1, 1978-August 31, 1980.** Ragland, K.W. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering). Nov 1980. Contract FG01-78ET12240. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011397.

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The objectives of the work reported are: to obtain experimental data on the burning rate of individual coal particles in a bench scale fluidized bed; to develop a model of the burning rate of coal particles in a fluidized bed and compare the theory with the experimental data; and to investigate and analyze the unburned carbon carry-over from a bench scale fluidized bed. A six-inch diameter quartz-walled fluidized bed combustor with a 24 kW air preheater was built and operated. The heater uses 12 silicon carbide electrodes and delivers 30 SCFM at 1600 degrees F. Measurements of the burning rate and characteristic combustion times of a bituminous Kentucky coal, a sub-bituminous Montana coal, and a Texas lignite were conducted in a jet of heated gas and in a small externally heated fluidized bed. Reaction rate constants for the coal char were calculated and compared to theoretical diffusion and kinetic rate constants. Data were obtained on the amount and size distribution of unburned carbon carry-over from the combustion of single coal particles aerodynamically suspended in a heated jet of air/nitrogen. This setup simulated the flow conditions in a fluidized bed. Cascade impactor tests were also conducted. (LEW)

25284 **(DOE/PC/30216—T10) Characteristics of coal/light hydrocarbon slurries in spray combustion. Final report, September 1, 1980-June 30, 1983.** Grosshandler, W.L.; Crowe, C.T.; Chung, J.N. (Washington State Univ., Pullman (USA). Dept. of Mechanical Engineering). Sep 1983. Contract FG22-80PC30216. 169p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE84006830.

A three-pronged research program has contributed to an understanding of the physical phenomena controlling the combustion of coal/liquid sprays. The three major objectives have been the following: (1) to develop an experimental facility to measure the droplet size produced by air-assisted atomization of coal/methanol slurries, and to perform preliminary measurements of the effects of particle size and concentration on droplet size; (2) to study the feasibility of heterogeneous nucleation in a coal/hydrocarbon slurry droplet experiment, and develop a numerical model for the evaporation and combustion of these droplets; and (3) to develop an experimental facility to study the effects of propane, steam, and methanol on the conversion of coal nitrogen to nitric oxide within a laminar diffusion flame. This report summarizes progress made in achieving these objectives under the following three sections: (1) atomization of coal slurries; (2) mathematical modeling of slurry droplets; and (3) combustion of coal/pre-vaporized fuel mixtures. Each of the three sections gives details on the experimental facilities developed, presents the results of the experiments performed or the numerical analyses, and concludes with recommendations and implications of the research performed. 144 references, 66 figures, 19 tables.

25285 **(DOE/PC/60802—1) Aerosol formation from pulverized coal combustion. Quarterly reports 1, 2 and 3.** Peterson, T.W. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). 1 May 1984. Contract FG22-83PC60802. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010723.

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Three types of pulverized coal were burned in a laboratory furnace under various combustion configurations. Pulverized samples of Utah bituminous, Beulah (North Dakota) lignite and Texas lignite coals were burned at a rate of 2.5 kg/h in a laboratory furnace. Aerosol size distributions were measured at various positions within the convection section, and temperature and gas compositions were measured throughout. The evolution of the submicron particle size distribution within the convection section for the three coals was similar, although the location of the initial particle mode at the convection section inlet varied with coal type. While staged combustion of Utah bituminous coal had a variable effect on the volume of submicron aerosol produced, staged combustion of the lignites caused a definite increase in the submicron aerosol volume. Vapor enhancement due to a localized reducing atmosphere, which would effect coals of higher ash volatility, is thought to explain this behavior. 39 references, 13 figures, 7 tables.

25286 **(EUR—8544-EN) Measurements of pulverized coal combustion under conditions simulating a blast furnace environment (Report on ECSC contract 7210-AA/601).** Bortz, S. (Commission of the European Communities, Luxembourg). 1983. 102p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Combustion of pulverized coal under conditions simulating injection into a blast furnace was studied. Four coals were tested and the effects of coal rate, blast temperatures from 900 degrees C to 1200 degrees C, coal fineness, injection position and momentum, on the combustion of these coals were characterized through visualization and measurements. The performance of the coals was very

dependent on the coal rank. The other parameters, particularly coal flow rate, also had a strong influence on the combustion rate. Indications are that the early combustion (< 10 ms) is determined by pyrolysis rates with volatile yields significantly in excess of the proximate analysis being measured for the bituminous coals. The combustion of the expelled volatile matter was found to be mixing limited, leading to soot formation. This problem was amplified with a high coal rate. The char combustion for all four test coals was slow, indicating that an assumption of complete combustion in the raceway region of a blast furnace is probably invalid except at very reduced coal rates.

25287 **(FWC/FWDC/TR—84/12) Investigation of pyrite as a contributor to slagging in eastern bituminous coals. Quarterly progress report 8, July 1-September 30, 1983.** Bryers, R.W. (Foster Wheeler Development Corp., Livingston, NJ (USA)). Apr 1984. Contract AC22-81PC40268. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010794.

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Each coal was low-temperature ashed and subjected to TGA. The thermograms for the low-temperature ash are compared with pure pyrite in Figure 3.20. Ignition of pyrite contained in the low-temperature ash appears to occur at the same temperature as ignition of pure laboratory-grade pyrite. Decomposition, however, proceeds at a much reduced rate. Pyrite ignition in the heaviest fraction of coal appears to be excited by trace amounts of carbon. The delay in pyrite combustion in low-temperature ash may be the result of a slight alteration of the pyrite during ashing or the presence of excessive quantities of ash. Quite apparently, structure, source, size, and contamination by other minerals alter the ignition and combustion rate of pyrite and the formation of an intermediate phase FeS with a substantially lower burning rate. Small quantities of carbon can improve ignition but suppress burnout; large quantities of carbon obscure pyrite combustion. Coal-derived pyrite does not ignite as well as bituminous coals in general, and burnout of FeS formed in the latter stages of combustion is poor, approaching the time required for the burnout of anthracite. Since the association of pyrite with other carbonaceous matter and minerals varies substantially between gravity fractions and since some gravity fractions may contain maceral groups, such as fusinite, which further impede combustion, thermal analysis should be performed on individual gravity fractions. The results of such an analysis will be discussed in a later section. The slower decomposition rates of pyrite compared with lignite and bituminous coal derivatives introduce the potential for the formation of a temporary low-temperature melt as part of the Fe-S-O system.

25288 **Fluidized-bed coal combustion: in-bed sorbent sulfation model.** Fee, D.C. (Argonne National Lab., IL); Wilson, W.I.; Myles, K.M.; Johnson, I.; Fan, L.S. *Chemical Engineering Science;* **30**: No. 11, 1917-1925(1983).

A model is developed to account for sulfur capture within the sorbent bed of a fluidized-bed coal combustor. The model is expressed in an analytical form that contains two sorbent specific parameters. The sorbent parameters, which describe the kinetics of the sulfation reaction are obtained from thermogravimetric analysis data on the SO_2-sorbent reaction. Various hydrodynamic and mass transfer properties in relation to the bubbling phenomena are taken into consideration in the model. The predictions of the model which are made without arbitrary parameters, compare favorably with the experimental data on sorbent performance from large scale experimental fluidized-bed coal combustors. 2 figures, 1 table.

0150 Marketing And Economics

25289 **(DOE/EIA—0121(83/4Q)) Quarterly coal report, October-December 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1984. 89p. NTIS, PC A05/MF A01; - GPO; GPO Dep. Order Number DE84010351.

Despite the large depletion in inventories, coal production in the second half of 1983 rose 1.3% above output in the second half of 1982. Coal production in 1983 totaled only 784.9 million short tons, 6.4% less than the 838.1 million short tons produced in 1982. Due to economic recovery total domestic coal consumption increased 4.2%; electric utility coal consumption increased 5.3%; exports declined by approximately one-fourth; coal consumption at coke plants declined 9.5%; and coal consumption in the other industrial sector increased 2.9%. Coal exports in 1983 fell to 77.8 million short tons, a decline of 26.8% below 1982 and 30.9% under 1981. Strong competition from other coal exporting countries was the major contributing factor for the drop in U.S. exports. High stockpile levels in many countries also contributed to lower foreign demand. Coal stocks held by consumers totaled 26.6 million short tons below the beginning inventory. Stocks held by producers and distributors were reduced from 36.8 to 33.9 million short tons during 1983. The average quarterly prices of coal received by electric utilities, coke plants, and other industrials declined each quarter during 1983. The average price per short ton of coal delivered to utilities fell from $35.42 in the first quarter to $34.61 in the fourth quarter. During these periods of 1983, the average price of coal delivered to coke plants fell from $62.29 to $56.92. Other industrial consumers paid on the average $39.81 per short ton in the first quarter, and $39.12 per short ton in the fourth quarter.

25290 **(DOE/EIA—0292(83)) Assessment of the quality of selected EIA data series. Coal and electric power data from 1977 to 1982.** (USDOE Energy Information Administration, Washington, DC. Office of Statistical Standards). Apr 1984. 208p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010533.

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Coal production, coal consumption at electric utilities, total net generation, and total installed nameplate capacity are discussed with emphasis on national data. However, coal production data for the seven largest coal-producing states and Colorado are also discussed. The purpose of this report is to help the user understand where error may enter some of EIA's key series of coal and electric power data by presenting comprehensive descriptions of the series and by comparing EIA estimates with other similar series. In addition, this report discusses steps EIA has taken to minimize these potential errors.

0160 Health And Safety

REFER ALSO TO CITATION(S) 25226, 25268, 27212

25291 **(BMFT-FB-HA—83-030) Improvement of safety in fighting mine fires, by means of inertization of fire zones.** Genthe, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 138p. (In German). NTIS (US Sales Only), PC A07 MF/A01. Order Number DE84750938.

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The objective was to develop an inertization process improving previous fire-fighting techniques in mines and permitting an inert gas feed rate of 250 m^3/min. When evaluating the existing literature, it was found that the novel inertization methods conceived abroad were not transferable to West German coal mining. Therefore, noble gases, liquid nitrogen, carbon dioxide, and combustion gases were tested as to their suitability as inert gases, considering local requirements. Liquid nitrogen turned out to be the most promising medium among these, so that, in cooperation with Linde AG and other manufacturers, the prototype of a mobile inertization plant functioning on liquid nitrogen was developed. The plant is constituted of: a mobile, high-capacity evaporator; a mobile LN_2-storage tank of 45.000 l capaxity: a special hose system transporting the gaseous nitrogen, of 150 mm internal diameter and 20 or 30 m long hose sections; 60 special containers storing the hoses ready for use; a special low-body trailer for transporting the hose containers; a tractor for transporting the evaporator vehicle; storage tanks and container cars serving the different mines; a measuring truck for remote transmission of measuring data and remote operation of the evaporator vehicle; a "power-pack" truck housing transformer station and emergency power supply. - This plant has proven its usefulness in many incidents.

25292 **(SVC—83-38) Cr (VI) and other metallic mutagens in fly ash and welding fumes.** Stern, R.M.; Thomsen, E.; Furst, A. (Svejsecentralen, Glostrup (Denmark)). 1983. 25p. (CONF-8309223—). Svejsecentralen, Glostrup, Denmark.

From 1. international workshop on carcinogenic and/or mutagenic metals; Geneva, Switzerland (11 Sep 1983).

Particulate samples taken from both the indoor (working) and outdoor (community) environments contain a wide range of metallic trace elements most of which are mutagenic in at least one of the short term tests for genotoxicity currently in use. Because of the demonstrated presence of a short lived biologically active species (Cr(VI)), and the uncertainty with which the results of the screening of metallic compounds in short term tests can be interpreted in terms of human risk great care must be taken to assure the appropriate collection, storage, and chemical and biological assay of such material. The sensitivity of the results for fly ash and welding fumes to variations in these protocols is demonstrated and discussed.

25293 **Computer programs for statistical graphics in safety analysis.** Kogut, J. (Mine Safety and Health Administration, Denver, CO). pp 544-551 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

This paper describes three programs, currently in use within MSHA, for graphic analysis of accident frequency data. The first program, TREND, plots confidence bands for curved trends in data compiled over a period of time. In addition to detecting statistically significant upward or downward trends, the program can be used to determine whether an observation at a particular time deviates significantly from the historical pattern. The second program,, POIPORP, plots interval estimates for the risk of accident in each of several environments, given an observed number of incidents and exposure time at each environment. POIPORP is designed to quantify the uncertainty implicit in incidence rates based on limited information and to facilitate statistically valid comparisons among the rates. The third program, CINDY, plots dynamically adaptive control charts for accident or injury experience at a given location. These charts are used to detect statistically significant departures from a changing standard or a previously established trend. All three programs are written in FORTRAN IV, utilizing DISSPLA and IMSL. They exemplify forms of statistical analysis that would not be practical without a computer. Use of the programs is illustrated with applications to coal mine fatality and injury experience.

25294 **Using computers to enhance the safety of mining operations.** Daling, P.M.; Kerkering, J.C. (Battelle Northwest Laboratory, Richland, WA). pp 538-543 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

This paper discusses a study performed to evaluate the feasibility of transferring formal system safety assessment technology to the mining industry. A representative listing of formal techniques was evaluated to select the most useful methods for the mining industry to implement. Criteria for selecting methods included the interests, needs, and requirements of mine safety officials. This paper describes one of the selected methods, preliminary hazards analysis (PHA), and illustrates the analysis procedure for a mining example. This study also includes an assessment of the adaptability of selected methods to a user-interactive computer system for use by mine safety personnel. This paper includes a description of a conceptual computerized PHA-type safety program that facilitates performance of the safety analysis and can accommodate updates and revisions as necessary.

25295 **Use of the computer in processing accident, injury, illness and employment information in United States mines.** Powers, K.J. (Health and Safety Analysis Center, Mine Safety and Health Administration, Department of Labor, Denver, Colorado). pp 535-537 of Proceedings of the First Conference on Use of Computers in the Coal Industry. Wang, Y.J.; Sanford, R.L. New York, NY; S.M.E. of A.I.M.E. (1983). (CONF-830826—).

From 1. conference on use of computers in the coal industry; Morgantown, WV, USA (1 Aug 1983).

The Mine Accident, Injury, Illness and Employment Database at the Mine Safety and Health Administration's Health and Safety Analysis Center is a computerized system that stores accident, injury, illness and employment data about all coal and metal/nonmetal mines in the United States. The paper discusses the system for collecting, storing, analyzing, and reporting this information and how these data are used in the ongoing effort to increase the health and safety in this nation's mines.

02 PETROLEUM

0201 Reserves

25296 **(USGS-OFR—83-122) Estimated oil and gas reserves, Gulf of Mexico Outer Continental Shelf and Continental Slope.** Hewitt, J.E.; Brooke, J.P.; Knipmeyer, J.H. (Geological Survey, Denver, CO (USA)). 1983. 19p. USGS-OFS, Box 24524-Denver Federal Center, Denver, CO 80225.

Remaining recoverable reserves of oil and gas in the Gulf of Mexico Outer Continental Shelf and Continental Slope have been estimated to be about 2.98 billion barrels of oil and 39.8 trillion cubic feet of gas, as of December 31, 1982. These reserves are recoverable from 468 studied fields under the Federal submerged lands off the coasts of Louisiana and Texas. An additional 53 fields, discovered since December 31, 1980, have not been sufficiently developed to permit a reasonably accurate estimate of reserves. Original recoverable reserves are estimated to have been 8.56 billion barrels of oil and 98.1 trillion cubic feet of gas from 484 fields in the same geographic area. Included in this number are 16 fields that are depleted and were abandoned; not included are the 53 insufficiently developed fields. Estimates were made for individual reservoirs in 382 fields and on a field-wide basis for the other 102 fields. 5 references, 7 figures, 3 tables.

25297 **(USGS-OFR—83-402) Procedures for petroleum resource assessment used by the US Geological Survey - statistical and probabilistic methodology.** Crovelli, R.A. (Geological Survey, Denver, CO (USA)). 1983. 24p. US Geological Survey-OFS, Box 25425-Denver Federal Center, Denver, CO 80225.

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Individual appraisals are made for each of the assessment areas using petroleum geology, volumetric-yield procedures, exploration histories, and, in some areas, finding-rate studies and structural analyses as a basis for subjective assessments of oil and gas. A lognormal distribution is fitted using subjective low, high, and modal estimates to determine a conditional probability distribution for each area. By applying the marginal probability to the conditional probability distribution, a probability distribution of the quantity of undiscovered resource is established. To obtain total resource estimates for a region of more than one area, the probability distributions for the individual areas composing the region are aggregated by a Monte Carlo technique. From an aggregate probability distribution, final estimates are obtained for the region. 6 references, 7 figures.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 26151

0203 Drilling And Production

REFER ALSO TO CITATION(S) 26151

25298 **(DOE/ET/60004—T5) Development of an analytical framework to assess the role of new technologies for liquid and gaseous fuels. Volume IV. Decision analysis of national research and development funding for unconventional oil technologies. Final report.** Nesbitt, D.M.; North, D.W.; Phillips, R.L. (Decision Focus, Inc., Los Altos, CA (USA)). Dec 1980. Contract AC05-79ET60004. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84011236.

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This analysis explores the issue of whether developing new technology to exploit the light oil, heavy oil, and tar sands resources is in the national interest. For purposes of this analysis, we will term light oil, heavy oil, and tar sands recovery technologies collectively as enhanced oil recovery technologies (EOR). When we use the term EOR, it will be understood that we are referring to all three of the aforementioned resources and the technologies necessary to exploit them. EOR does not consist of a single technology but rather of a number of related technologies for extracting oil unreachable by primary and secondary techniques or bitumen from tar sands. EOR technologies considered to be currently proven are relatively primitive and apply only to a limited number of reservoirs, principally those containing heavy oil. Although more advanced EOR techniques have removed 90% of the oil from core samples in the laboratory, they have not yet been demonstrated in field tests. Substantial scientific and engineering progress will be needed to reproduce laboratory results under field conditions. Finally, the diversity of known reservoirs indicates that, in all likelihood, no single EOR technology will be usable on more than a small fraction of known reservoirs. The appropriate level of national expenditure on EOR R and D is the focus of this analysis. This report describes an analytical framework and a set of assumptions designed to gain insight regarding the appropriate level of national (public plus private) expenditures on EOR R and D. The analysis described herein has been designed to address this question only; it does not address the problem of the optimal government/industry split or the best EOR technology mix.

25299 **(DOE/SF/11564—6) Flow of foam through porous media.** Owete, O.S.; Brigham, W.E. (Stanford Univ., CA (USA). Petroleum Research Inst.). Jun 1984. Contract AC03-81SF11564. 124p. (SUPRI-TR—37). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012410.

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This study focuses on the pore level behavior of foam in porous media. Air was injected into porous micromodels which had previously been filled with an aqueous solution of surfactant. The micromodels consist of an etched silicon wafer anodically bonded to a glass plate. The model simulates a monolayer of porous matrix. Three homogenous models of different pore dimensions and one heterogeneous model were used. Visual observations were made to determine the flow characteristics of foam under varying air injection rates, pore dimensions and surfactant concentration. Foam flow mechanisms, as observed in the micromodels, were recorded on video tapes. These tapes are available at the Stanford University Petroleum Research Institute, Stanford, California. The observed mechanisms can be broadly classified into two: membrane and foam bubble propagation. Propagation of membranes, air-liquid interfaces, occurred in the homogeneous porous media at both low and high surfactant concentrations, and in the heterogeneous model at low surfactant concentration. Foam bubble propagation occurred only in the heterogeneous model at high surfactant concentrations. In the homogeneous micromodels, the wetting phase (surfactant solution) formed a continuous liquid network around the matrix. The air was found to propagate as tubular bubbles moving and extending over several pores. The flow mechanism was only slightly affected when different air injection rates, pore dimensions and surfactant concentrations were used. Foam was found to be generated in the heterogeneous model. Air and liquid were propagated by a combination of channel flow (with liquid confined to small pores) and a bubble break and reform process. The break and reform process was caused by snap-off actions at pore constrictions. A considerable reduction of effective mobility was observed in the presence of foam, compared to air-water systems without surfactant. 44 references, 43 figures, 5 tables.

25300 **(NMERDI—2-69-3307) Development of mobility control methods to improve oil recovery by CO_2. Final report.** Heller, J.P.; Taber, J.J. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Feb 1984. 95p. NTIS, PC A05/MF A01 - NMERDI. Order Number DE84900889.

Because the efficiency of oil recovery from most reservoirs is disappointingly low, scientific research into the mechanisms of oil displacement promises to be very productive. An increasingly popular, but not fully understood or exploited oil recovery process uses highly compressed CO_2 as a displacing fluid to force the crude oil from reservoir rock. This report discusses concepts, methods, and results from a research project that investigated an important outstanding problem in CO_2 flooding. The problem is caused by the very low viscosity of even liquid CO_2, and results in the formation of frontal instabilities of viscous fingers during displacement. These fingers break through to the producing well, causing high rates of CO_2 use with lowered displacement efficiency, reducing the amount of oil that can be produced economically from the field. In the project, two general methods of thickening CO_2 were studied to reduce the incidence of early breakthrough and improve the efficiency of oil displacement by CO_2. The two additives are CO_2 foam and CO_2-soluble polymers to be used as direct thickeners. The first of these is closer to commercial use, but the second also shows great promise. The report also describes experiments to demonstrate both the usefulness and the mode of field use of these mobility control additives. 69 references, 15 figures, 13 tables.

25301 **(NMERDI—2-70-3201) Enhanced oil recovery by CO_2 foam flooding. Final report.** Patton, J.T. (New Mexico State Univ., Las Cruces (USA). Dept. of Chemical Engineering). Mar 1984. 95p. NTIS, PC A05/MF A01 - NMERDI. Order Number DE84901033.

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During the past year significant progress has been made in developing a commercial method of reducing the mobility of carbon dioxide in enhanced oil recovery processes. The three prime chemical additives for mobility control Stepanflo-50, Pluradyne SF-27, and Exxon LD 776-52, were evaluated. The results of these tests indicate that mobility control additives can enhance CO_2 miscible tertiary oil recovery. Equally significant is the fact that the improvement in displacement efficiency correlates with the two-phase flow mobility control data obtained in the earlier dynamic screening experiments. A new commercial additive, a synthetic sulfonate, was identified that appears to be optimum for reservoirs where fresh water will be used to inject the surfactant solution. It can also be considered for limited brine applications at elevated temperatures. This is encouraging since some of the previously identified additives are chemically unstable at temperatures encountered in some petroleum reservoirs. 93 references, 22 figures, 4 tables.

25302 **(SAND—83-2404) Comparison of formation resistivity changes induced by wet and dry in situ combustion.** Wayland, J.R.; Lee, D.O.; Montoya, P.C.; Cabe, T.J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010751.

Use of controlled source audio magnetotelluric (CSAMT) techniques to map thermal fronts associated with enhanced oil recovery (EOR) processes depends upon knowledge of the changes in formation electrical resistivity. Measurement of these changes in the laboratory required the development of a technique which survives high temperatures and a very corrosive environment while measuring over a frequency range of 5 Hz to 5000 Hz. The apparatus to make these measurements is described. The results from two laboratory forward wet and dry combustion tests in the University

of Calgary combustion tube are presented. It is found that there is a two-decade change for dry and a three-decade change for wet combustion as the fire front traverses through a region. A comparison of the results from the wet and dry combustion tests is made. The frequency dependency of the resistivity changes suggests means of improving CSAMT sensitivity. 6 references, 23 figures.

25303 **(SAND—83-7121) Development of a downhole steam generator system.** (Foster-Miller, Inc., Waltham, MA (USA)). Apr 1984. Contract AC04-76DP00789. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011521.

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This report describes the development of a downhole steam generator system for use in enhanced oil recovery. The system is composed of four major components: A state-of-the-art review indicated that advances in technology would be necessary in two areas (high pressure combustion and high temperature packer seals) in order to fabricate a field-worthy system. As a result, two tasks were undertaken which resulted in the development of a novel ceramic-lined combustor and a unique all-metal packer. These elements were incorporated into an overall system design. Key system components were built and tested in the laboratory. The program culminated in a successful simulated downhole test of the entire system, less tube string, at Sandia National Laboratories. 5 references, 41 figures, 9 tables.

25304 **(SAND—84-0050) Update of comparative analysis of steam delivery costs for surface and downhole steam drive technologies.** Hart, C.M.; Muir, J.F. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011522.

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A review and update is presented of a previous analysis which compared the economic performance of the surface and downhole steam delivery technologies investigated in the Department of Energy's Project DEEP STEAM for the enhanced recovery of heavy oil from deep reservoirs. Emphasis is placed on an examination and revision of the compression and wellbore heat loss assumptions and their effects on sandface steam delivery costs. Multistage compression with intercooling and aftercooling, increased overall compression efficiency, and waste heat scavenging all serve to decrease the cost of steam generated downhole and reduce differences among the various surface and downhole delivery system costs. Wellbore heat loss increases dramatically when water is present in the annulus, causing a reduction in the depth to which surface steaming is effective and an increase in steam delivery costs. Other concerns potentially impacting the cost comparisons are discussed. These include: crude versus diesel generator fuel, reliability of both surface and downhole hardware, capital equipment costs, surface transmission losses, and the assumption of hydrostatic reservoir pressure. 16 references, 19 figures, 1 table.

25305 **(SAND—84-7119) Enhanced Recovery Packer Program. Phase III. Final report.** Veal, G.R.; Bilyeu, G.D.; Davis, D.L.; Hirasuna, A.R. (L'Garde, Inc., Newport Beach, CA (USA)). Apr 1984. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011005.

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This final report is a comprehensive description of work performed by L'Garde, Inc., on the third and final phase of the Enhanced Recovery Packer Program under Sandia/DOE Contract 74-7854. This unit of work is the final portion of overall effort to develop an enhanced oil recovery packer concept, the MIN-STRESS II Packer, to the point of demonstration. The concept was originally conceived by L'Garde under a company-funded study. The major tasks reported herein include update of the original conept, packer detail design, development testing, fabrication and testing of a full-scale prototype to demonstrate the capability of the packer to perform in a steam injection environment at 371° (700°F) and 21 MPa (3000 psi). The program culminated with a very successful demonstration of the MIN-STRESS II Packer. 12 figures, 3 tables.

25306 **Three-dimensional hydraulic fracture propagation in the presence of stress variations.** Palmer, I.D.; Carroll, H.B. (Oral Roberts Univ.). *SPEJ, Society of Petroleum Engineers Journal;* **23**: No. 6, 870-878(Dec 1983).

Models of three-dimensional (3D) fracture propagation are being developed to study the effect of variations of stress and rock properties on fracture height and bottomhole pressure (BHP). Initially a blanket sand bounded by zones of higher minimum in-situ stress is considered, with stresses symmetrical about both the pay-zone axis and the wellbore. An elliptical fracture perimeter is assumed. Fluid flows are one-dimensional (1D) Newtonian in the direction of the pay zone. Two models, FL1 and FL2, are developed. In FL1, a discontinuous stress variation is approximated by a y^2 variation in the vertical coordinate, and the fracture criterion, K /SUB i/ =K /SUB c/ , is satisfied at both major and minor axes. The net pressure at the tip, L /SUB f/ , of the long axis required by the boundary condition K /SUB i/ =K /SUB c/ does not seem crucial in determining fracture height or BHP (compare with one group of published models that assumes p=0 at L /SUB f/). Model FL2 properly represents the discontinuous stresses, and satisfies K /SUB i/ =K /SUB c/ at the wellbore but not at the tip of the long axis.

25307 **The phase behavior of simple salt-tolerant sulfonates.** Barakat, Y.; Fortney, L.N.; LaLanne-Cassou, C.; Schecter, R.S.; Wade, W.H.; Weerasooriya, U.; Yiv, S. (Univ. of Texas). *SPEJ, Society of Petroleum Engineers Journal;* **23**: No. 6, 913-918(Dec 1983).

Alkane and α-olefin sulfonates can be used to produce optimal microemulsion formulations having very high salinity tolerance (including divalent ion) while maintaining large solubilization parameters and low interfacial tensions (IFT's). Such molecules require elevated temperatures or higher alcohol concentrations to suppress liquid crystal formation. As in other species, solubilization is inversely related to width of the threephase regime, and IFT and solubilization are strongly coupled.

25308 **Correlation of crude oil steam distillation yields with basic crude oil properties.** Wu, C.H.; Elder, R.B. (Colorado School of Mines). *SPEJ, Society of Petroleum Engineers Journal;* **23**: No. 6, 937-945(Dec 1983).

Steam distillation can occur in reservoirs during steam injection and in-situ combustion processes. To estimate the amount of vaporized oil caused by steam distillation, we established correlations of steam distillation yields with the basic crude oil properties. These correlations were based on steam distillation tests performed on 16 crude oils from various parts of the U.S. The gravity of oils varied from 12 to 40°API (0.99 to 0.83 g/cm³). The viscosity of oil ranged from 5 to 4,085 cSt (5 to 4085 mm²/s) at 100°F (38°C). The steam distillations were performed at a saturated steam pressure of 220 psia (1.5 MPa). One oil sample was used in experiments to investigate the effect of steam pressure (220 to 500 psia (1.5 to 3.4 MPa)) on the steam distillation yield. The experiments were carried out to a steam distillation factor (V /SUB w/ /V /SUB oi/) of 20, with the factor defined as the cumulative volume of condensed steam used in distillation, V /SUB w/ , divided by the initial volume of oil, V /SUB oi/ . At a steam distillation factor of 20, the distillation yields ranged from 13 to 57% of the initial oil volume. Several basic crude oil properties can be used to predict steam distillation yields reasonably well. A correlation using oil viscosity in centistokes at 100°F (38°C) can be used to predict the steam distillation yield within a standard error of 4.3%. The API gravity can be used to estimate yields within 5.6%. A gas chromatographic analysis was made for each crude oil to obtain the component boiling points (simulated distillation temperatures). A correlation parameter was selected from the simulated distillation results that can be used to estimate the steam distillation yields within 4.5%.

25309 **Process for tertiary oil recovery using tall oil pitch.** Radke, C.J. (to Dept. of Energy). US Patent Application 6-517,138. 25 Jul 1983. 11p. Contract AC03-76SF00098.

A process and compositions for enhancing the recovery of acid crudes are disclosed. The process involves injecting caustic solutions into the reservoir to maintain a pH of 11 to 13. The fluid contains an effective amount of multivalent cation for inhibiting alkaline silica dissolution with the reservoir. A tall oil pitch soap is added as a polymeric mobility control agent. (DMC)

25310 **Fire flood method for recovering petroleum from oil reservoirs of low permeability and temperature.** Kamath, K. (to Dept. of Energy). US Patent Application 6-491,133. 3 May 1983. 16p.

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The present invention is directed to a method of enhanced oil recovery by fire flooding petroleum reservoirs characterized by a temperature of less than the critical temperature of carbon dioxide, a pore pressure greater than the saturated vapor pressure of carbon dioxide at said temperature (87.7°F at 1070 psia), and a permeability in the range of about 20 to 100 millidarcies. The in situ combustion of petroleum in the reservoir is provided by injecting into the reservoir a combustion supporting medium consisting essentially of oxygen, ozone, or a combination thereof. The heat of combustion and the products of this combustion which consist essentially of gaseous carbon dioxide and water vapor sufficiently decrease the viscosity of oil adjacent to fire front to form an oil bank which moves through the reservoir towards a recovery well ahead of the fire front. The gaseous carbon dioxide and the water vapor are driven into the reservoir ahead of the fire front by pressure at the injection well. As the gaseous carbon dioxide cools to less than about 88°F it is converted to liquid which is dissolved in the oil bank for further increasing the mobility thereof. By using essentially pure oxygen, ozone, or a combination thereof as the combustion supporting medium in these reservoirs the permeability requirements of the reservoirs are significantly decreased since the liquid carbon dioxide requires substantially less voidage volume than that required for gaseous combustion products. 1 table.

25311 **Data base streamlines DOE EIA-23 reporting.** Patton, E.N. Jr. *Oil and Gas Journal;* 77: 255-258(12 Nov 1979).

PSI Energy Software presents a computer data-base system developed to help producers report the extensive reserve and production information required on the US Department of Energy's EIA-23 annual survey forms. The reserves and production system (RAPS) is a data management tool accessed via General Electric Information Services Co.'s teleprocessing network. Without making a large financial investment for computer hardware, operators can use RAPS to store, compute, maintain, and report information on oil and gas reserves and production along with data concerning various reserves classifications, geological information, ownership interests, gas contract, and commitment status. The program allows for conversion of gas volume using various temperature and pressure bases. It also converts data to and from metric units.

0204 Processing

25312 (LBL—13500, pp 1.29-1.30) **Reactions of inorganic and organoarsenic compounds with substituted catechols.** Fish, R.H.; Tannous, R.J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 26159

25313 **(DOE/EI/10667—T1) EMF 7 model comparisons: key relationships and parameters.** Hickman, B.G. (Stanford Univ., CA (USA). Energy Modeling Forum). Dec 1983. Contract FG01-80EI10667. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010590.

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A simplified textbook model of aggregate demand and supply interprets the similarities and differences in the price and income responses of the various EMF 7 models to oil and policy shocks. The simplified model is a marriage of Hicks' classic IS-LM formulation of the Keynesian theory of effective demand with a rudimentary model of aggregate supply, combining a structural Phillips curve for wage determination and a markup theory of price determination. The reduced-form income equation from the fix-price IS-LM model is used to define an aggregate demand (AD) locus in P-Y space, showing alternative pairs of the implicit GNP deflator and real GNP which would simultaneously satisfy the saving-investment identity and the condition for money market equilibrium. An aggregate supply (AS) schedule is derived by a similar reduction of relations between output and labor demand, unemployment and wage inflation, and the wage-price-productivity nexus governing markup pricing. Given a particular econometric model it is possible to derive IS and LM curves algebraically. The resulting locuses would show alternative combinations of interest rate and real income which equilibrate real income identity on the IS side and the demand and supply of money on the LM side. By further substitution the reduced form fix-price income relation could be obtained for direct quantification of the AD locus. The AS schedule is obtainable by algebraic reduction of the structural supply side equations.

25314 **(DOE/EIA—0109(84/02)) Petroleum supply monthly.** (USDOE Energy Information Administration, Washington, DC). Apr 1984. 99p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84010543.

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This issue features: motor gasoline outlook for summer 1984; recent motor gasoline trends; what is motor gasoline; new patterns emerging in petroleum imports and exports; Caribbean refinery industry; and export regulations in addition to summary statistics for February and March 1984.

25315 **(DOE/EIA—0380(84/01)) Petroleum marketing monthly.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Apr 1984. 117p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84008514.

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Information and statistical data are presented for petroleum products, including motor gasoline, distillates, residuals, jet fuel, kerosene, and propane. The publication provides petroleum products sales statistics for use by industry, government, and private sector analysts, educational institutions, and consumers.

25316 **(DOE/EIA—0380(84/02)) Petroleum Marketing Monthly, February 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). May 1984. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011713.

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This report presents information and statistical data about a variety of petroleum products, including motor gasoline, distillates, residuals, jet fuel, kerosene, and propane. Four types of petroleum product statistics are provided: sales prices, sales volumes, percentages of petroleum product sales, and first sales of petroleum products for consumption. Monthly summaries of petroleum product statistics by PAD districts and individual states are included. (DMC)

25317 **(DOE/PE/70502—T1) Oil-price shock: market response and contingency planning.** Horwich, G.; Weimer, D.L. (American Enterprise Inst. for Public Policy Research, Washington, DC). 1984. Contract FG01-83PE70502. 187p. American Enterprise Inst. for Public Policy Research, 1150 17th Street, N.W., Washington, DC 20036.

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This volume suggests strategies to ease the stress posed by shortfalls in the oil supply. After describing the impact of such crises both in general terms and in particular instances in the 1970s, the book examines means of contending with future disruptions, including the role of the strategic petroleum reserve, financial assistance programs, demand restraint measures, and international oil sharing. Horwich and Weimer find little merit in mandatory demand-restraint measures or in proposals to reduce payroll taxes

as an offset to energy costs. They argue that the sharing of oil supplies under the international agreements, carried out at world market prices, is unnecessary as well as harmful to participating countries that are members of the Organization for Economic Cooperation and Development. The centerpiece of the strategy that the authors regard as optimal is early drawdown of the strategic petroleum reserve.

25318 **(DOE/US/31018—T1) DOE analysis of the appropriate size of the Strategic Petroleum Reserve.** (MTSC, Inc., Bethesda, MD (USA)). 30 Nov 1979. Contract AC01-80US31018. 75p. NTIS, PC A04; 3; GPO Dep. Order Number DE84010734.

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The analysis concludes that the US should proceed with the third 250 million barrels (MMB) in the Strategic Petroleum Reserve (SPR) to help assure adequate petroleum to maintain health, safety and national security in the event of a very severe interruption, and secondarily to reduce the severe economic impacts of even relatively small oil interruptions. The analysis shows that an SPR of at least 550 MMB is justified on other than economic grounds and that it should be developed as fast as possible to help assure that the US can survive a very severe interruption. A Primary Reserve of 550 MMB is necessary to assure petroleum for critical survival uses, including food, shelter, heat, medical care and national security. Although the probability of a very large interruption is small, the impact on the health and safety of Americans and on our national security could be so devastating that it would be foolhardy not to insure against such risks. Appendices address: world production, consumption, prices and US imports; US and global oil shortfalls; ability to use private stocks; feasibility and hazards of reducing US oil consumption; cost-benefit analysis of SPR; and GNP loss function sensitivity. 3 figures, 11 tables.

25319 **(NP—4770230) Surprise price shifts, tax changes and the supply behaviour of resource extracting firms.** Van Long, N.; Sinn, H.W. (Mannheim Univ. (Germany, F.R.). Sonderforschungsbereich 5 - Staatliche Allokationspolitik im Marktwirtschaftlichen System). 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770230.

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Recent discussions about the macro-economic effects of a 'surprise' increase in the price of oil typically assume that such a surprise price rise will stimulate the extraction of oil. The purpose of this paper is to explore the micro-economic foundation (or the lack of it) for such assumptions. While it is well-known that the output of oil depends not only on its current price but also by the time profile of future prices, it seems to be useful to derive sufficient conditions for a positive increase or decrease in current output of oil in response to a surprise perturbation of the price path, brought about by changes in taxes or subsidies, or by exogenous international forces. The attention is restricted to the case of a competitive resource extracting firm (or a small oil producing economy) and refrain from discussing industry-wide (or world-wide) repercussions of changes in taxation. On the other hand, the model is, in a sense, more general than existing models because it is allowed for capital accumulation and for stock-dependent extraction costs.

25320 **(NP—4900949) Bering Sea summary report: Outer Continental Shelf oil and gas activities in the Bering Sea and their onshore impacts.** Deis, J.; Pierson, R.; Kurz, F. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Sep 1983. 86p. OCS, Office of Offshore Information Services, 12203 Sunrise Valley Drive, Reston, VA 22091.

Two federal offshore oil-and-gas lease sales have been held in the Bering Sea Subregion. Lease Sale 57, Norton Basin, was held on March 15, 1983. Lease Sale 70, St. George Basin, was held on April 12, 1983. The sale offered 479 tracts, of which 97 received bids. The Department of the Interior has indicated that it will accept 96 of the 97 high bids; however, to date, leases have not been awarded. The Department of the Interior was enjoined from issuing leases by the US District Court of Alaska because of possible impacts from postlease preliminary seismic activities on gray and right whales. In accordance with the Court's ruling, leases cannot be issued until the completion of a supplemental environmental impact statement, which is anticipated to occur in November 1983. Six lease offerings in the Bering Sea Subregion are scheduled through 1987. Six deep stratigraphic test wells are the only wells drilled to date in the Bering Sea Subregion. To date, oil companies have not submitted exploration plans for the Norton Basin Planning Area. Exploration in Norton Basin could begin in the summer of 1984, at the earliest. Exploration plans cannot be submitted for the St. George Basin Planning Area until the leases are awarded. At this time, various onshore areas are being considered as possible support bases for offshore oil-and-gas exploration. At this stage, before exploratory drilling has occurred and in the absence of a commercial discovery, plans for transporting petroleum from the Bering Sea to markets in the United States are unclear. The current estimates of risked resources for lands leased in Lease Sale 57, Norton Basin, are 33 million barrels of oil and 110 billion cubic feet of gas. Lease Sale 70, St. George Basin, estimates of risked resources for leased lands are 27 million barrels of oil and 310 billion cubic feet of gas. 55 references, 10 figures, 3 tables.

25321 **(NP—4900950) Pacific summary report: Outer Continental Shelf oil and gas activities in the Pacific and their onshore impacts.** Havran, K.J. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Sep 1983. 149p. OCS Office of Offshore Information Services, 12203 Sunrise Valley Drive, Reston, VA 22091.

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California has been a major oil-producing state for nearly a century. Its offshore heritage began as early as 1896. Today, the volume of oil and gas produced offshore California exceeds the offshore production of any other state, except Louisiana. The recent Santa Maria Basin oil field discoveries will ensure that it retains that prominence. The Department of the Interior's Minerals Management Service is conducting an active leasing program in the Pacific Region to encourage a continuing inventory of energy resources. Operating under the July 1982 final 5-year OCS oil and gas leasing schedule, the Minerals Management Service plans to make acreage in the Pacific Region available to oil companies in four lease offerings scheduled through June 1987. The next lease sale is planned for November 1983 within the Central and Northern California Planning Area. This report includes the most recent geological findings, resource and reserve estimates, the magnitude and timing of exploration, development, and production activities, transportation plans, and the nature and location of offshore facilities. 40 references, 17 figures, 12 tables.

25322 **(OCS—4900947) South Atlantic summary report.** Havran, K.J.; Wiese, J.D. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Dec 1983. 39p. OCS Information Program, Office of Offshore Information Services, 12203 Sunrise Valley Dr., Reston, VA 22091.

To date, four Federal offshore oil-and-gas leasing actions have occurred in the South Atlantic Region. Two additional South Atlantic lease offerings remain on the July 1982 final 5-year OCS oil-and-gas leasing schedule before June 1987. The South Atlantic Region consists of three major sedimentary basins: the Carolina Trough, the Blake Plateau, and the Southeast Georgia Embayment. Lease Sale 43, the first in the South Atlantic Region, featured blocks for exploration in the Southeast Georgia Embayment. Offshore operators drilled a total of six exploratory wells on blocks leased in Lease Sale 43. All were dry. The 43 leases from Lease Sale 43 have now expired, some blocks were relinquished earlier by their lease-holders. In the recent Lease Sales 56 and RS-2, and in the South Atlantic Lease Offering (July 1983), blocks leased were largely concentrated in the Carolina Trough Basin. Exploration of these blocks may begin anew in early 1984. The blocks are in deep water and will require careful, long-range planning before drilling can commence. As of July 1983, all 66 leases from the above three sales are active. Two plans of exploration have been approved by Minerals Management Service for exploration on blocks leased in Lease Sale 56. The plans are for Russell Area, Blocks 709 and 710, and Manteo Area, Block 510. Blocks 709 and 710 are held by ARCO, and Block 510 is held by Chevron. Based on current plans of exploration, operations will begin in 1984, first by Chevron, and sometime later by ARCO. Operations will be supported by a tem-

porary service base to be established at Morehead City, North Carolina. 6 references, 4 figures.

0208 Waste Management

25323 (LBL—13500, pp 1.34-1.37) **Processing of condensate waters from coal conversion.** King, C.J.; Mohr, D.H.; MacKenzie, P.D.; MacGlashan, J.D.; Munson, C.L.; Thompson, R.E. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 27085, 27209

25324 **(DOE/PO/10850—2-Vol.3) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Annual report for the Bryan Mound site, September 1982-August 1983. Volume III. Executive summary.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA)). Mar 1984. Contract AC96-83PO10850. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010695.

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This report describes the findings for the 12 months of post-disposal study conducted from September 1982 through August 1983. The areas of investigation are benthos, brine plume, data management, nekton, physical oceanography, and water and sediment quality. The specific objectives of this report are: (1) to describe the physical oceanographic and meteorological conditions which have been measured at the offshore diffuser site and in the surrounding waters; (2) to describe the effect of brine discharge on the benthic community in the diffuser site area; (3) to discuss the effect of the brine discharge on the quality of the water and sediment in the vicinity of the diffuser site; (4) to describe the measurement and empirical prediction of the areal and vertical extent of the brine plume; and (5) to characterize the effect of brine discharge on the nekton community in the vicinity of the diffuser. 2 figures.

25325 (LBL—13500, pp 5.14-5.16) **Groundwater impacts of enhanced oil recovery.** Sathaye, J.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Enhanced (tertiary) oil recovery (EOR) is a method which stimulates depleted oil reservoirs to yield additional crude oil. The method requires pumping steam, injecting chemicals or gases, or fire flooding the reservoirs to increase oil flow to the surface. Large quantities of brine are also produced with the oil. Federal and state regulations require safe disposal of brine by reinjecting it into the ground. During the reinjection process, brines can leak into surrounding freshwater aquifers. This study examined the potential for groundwater contamination from such leaks. Oil and chemicals which can contaminate groundwater aquifers were included in the analysis. The study also examined the water requirements for EOR techniques and evaluated the availability of water supplies.

0230 Properties

REFER ALSO TO CITATION(S) 26512

25326 (LBL—13500, pp 1.27-1.28) **Speciation of vanadyl porphyrins and non-porphyrin compounds in heavy crude oils by HPLC-GFAA and the competitive equilibria between vanadyl porphyrins and multidentate ligands.** Fish, R.H.; Komlenic, J.J.; Vermeulen, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25327 **(LBL—17477) Molecular characterization of vanadyl and nickel non-porphyrin compounds in heavy crude petroleums and residua.** Reynolds, J.G.; Biggs, W.R.; Fetzer, J.C.; Gallegos, E.J.; Fish, R.H.; Komlenic, J.J.; Wines, B.K. (Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 8p. (CONF-8406112—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009245.

From International symposium on characterization of heavy crude oils and petroleum residues; Lyon, France (25 Jun 1984).

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The molecular characterization of vanadium and nickel compounds in heavy crude petroleums has been the subject of current research. Arabian Heavy, Maya, Boscan, Cerro Negro, Prudhoe Bay, Wilmington Beta, Kern River, and Morichal crude petroleums have been examined. Fractions from D 2007 separations, porphyrin extractions, and solvent selective extraction with reversed phase column separations of these petroleums have been studied thoroughly by EPR. Important structural aspects are emerging from the presented data: (1) There are non-porphyrin metal complexes in the crude petroleums. (2) They appear to be smaller molecules with MW $<$ 400 which are liberated when the tertiary structure of the large asphaltics is denatured. (3) The first coordination spheres of this class of compounds are possibly 4N, N O 2S, and 4S. 10 references, 3 figures, 1 table.

25328 **(NBSIR—84-2821) Friction and wear characteristics of molecular compound classes from lubricating base oils. Part 1. Separation and chemical characterization.** Hsu, S.M.; Pei, P.; Gates, R.S. (National Bureau of Standards, Washington, DC (USA)). Feb 1984. Contract AC05-84OR21400. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010696.

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The approach chosen is to separate three lubricating base oils to provide basic structural information on the constituents in base oil that control friction and wear. After careful characterization of these compound classes, model compounds of various molecular structures used to measure their effects on friction and wear under different load/speed combinations.

25329 **Rotationally cooled laser-induced fluorescence/gas chromatography.** Hayes, J.M.; Small, G.J. (Ames Lab., Iowa). *Analytical Chemistry;* **55**: No. 7, 1202-1204(Jun 1983). Contract W-7405-ENG-82.

The rotationally cooled laser-induced fluorescence/gas chromatography (RC-LIF/GC) apparatus employed in this work is a modification of the continuous nozzle RC-LIF system described previously. To demonstrate the exciting capabilities of RC-LIF/GC, the authors selected mixtures of naphthalene, α-methylnaphthalene, and β-methylnaphthalene for study. The GC column employed permits physical separation of naphthalene from the methylnaphthalenes. Data for laboratory prepared mixtures are first used to establish that RC-LIF/GC is quantitative, highly sensitive, and practical (e.g., acceptable sample turn around time). Following this, the successful application of the technique to the direct determination and quantitation of the above molecules in a crude oil sample is demonstrated. 3 figures, 2 tables.

25330 **Determination of molecular weight distribution of aromatic components in petroleum products by chemical ionization mass spectrometry with chlorobenzene as reagent gas.** Sieck, L.W. (National Bureau of Standards, Washington, DC). *Analytical Chemistry;* **55**: No. 1, 38-41(Jan 1983).

A chemical ionization mass spectrometic technique for direct determination of the the molecular weight distributions of the major aromatic components in liquid fuels and other petro-products is discussed. The basic mechanism involves selective charge exchange reactions between chlorobenzene cations and the substituted benzenes and naphthalenes present in the sample. Chlorobenzene also serves as the solvent for the fuel, and screening of successive samples can be carried out with a 3-min turn-around time. Depending upon conditions, the paraffinic components present in the fuel are absent in the resulting mass spectrum.

0240 Storage

REFER ALSO TO CITATION(S) 25324

25331 **(SAND—83-2345C) Leached salt cavern design using a fracture criterion for rock salt.** Preece, D.S.; Wawersik, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 16p. (CONF-840633—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009457.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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In 1975 Congress passed the Energy Conservation Act to establish a US Strategic Petroleum Reserve (SPR) with a capacity of 750 million barrels of crude oil. The most economic storage medium was determined to be salt caverns leached in salt domes in Louisiana and Texas. Salt caverns existed at several sites when the reserve was created. These were obtained by the US Department of Energy (DOE) and used to initiate SPR oil storage. In order to meet the storage capacity approved by Congress, new caverns also had to be leached. To support the resulting design effort, finite element computer programs have been used to determine the creep closure and structural stability of salt caverns. Using site specific material properties including creep models, elastic moduli and fracture data, the finite element analyses have been replaced earlier empirical approaches to cavern design. This report presents results of such finite element analyses to determine the best cavern roof shape and the minimum pillar to diameter ratio, P/D. These numerical predictions indicate that the current cavern design is safe. 12 references, 7 figures, 2 tables.

25332 **(SAND—83-2583) AUTSKED: automated scheduling technique for leaching and filling activities at the Strategic Petroleum Reserve.** Sasser, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 76p. NTIS, PC A05; 3; GPO Dep. Order Number DE84011164.

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AUTSKED is an automatic activity scheduling technique developed for the Strategic Petroleum Reserve (SPR) program to assist the SPR system designers and operators in scheduling the leaching and oil filling of SPR salt caverns subject to environmental and engineering constraints. The scheduling method is described herein, and instructions for using the technique on Sandia National Laboratories' computer facility are included. The method provides for the scheduling of all operational activities to develop and fill up to 20 caverns at a site. 9 references, 2 figures.

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 25296

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 25335, 26151

25333 **(NMERDI—270-3303) Relationship of pore structure to fluid behavior in low permeability gas sands: Phase II. Final technical report.** Morrow, N.R.; Brower, K.R.; Kilmer, N.H. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). May 1984. 80p. NTIS, PC A05/MF A01. Order Number DE84901097.

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The objective of the project is to carry out advanced core analyses on tight sandstones and in particular explain: (a) what structural features cause their permeabilities to often show marked sensitivity to overburden pressure; (b) the superimposed effects of water saturation on gas permeabilities. Several interrelated aproaches are being taken to this work. A group of low permeability core samples were selected for their variation in geologic character, and permeabilities were measured. Detailed core analysis was carried out on each sample and correlations between pressure sensitivity and other core properties were investigated. In order to test the possible need for carrying out tests on tight sands at formation temperatures in addition to formulation pressures, a study of the combined effects of temperature and overburden pressure on gas permeabilities has been made. Results show temperature to have no significant effect on either liquid or gas permeabilities for overburden pressures ranging from 500 to 5000 psi. Photomicrographs of pore casts of numerous low permeability sandstones show pores to be flattened somewhat like the contact surfaces of a randomized honeycomb. In developing an explanation of sensitivity of permeability to overburden pressure, special attention was given to flow in crack-shaped pores. Attention has also been given to mathematical modelling of overburden sensitivity. More recently obtained test samples include a large number of cores from the Multiwell Test Site. Selection of cores is guided partly by the needs and interests of other investigators involved in the Multiwell Project.

25334 **(SAND—84-7129C) Porosity and permeability of tight sands.** Randolph, P.L.; Soeder, D.J.; Chowdiah, P. (Institute of Gas Technology, Chicago, IL (USA); Sandia National Labs., Albuquerque, NM (USA)). 13 May 1984. Contract AC04-76DP00789. 18p. (CONF-8405120—7). NTIS, PC A02; 3; GPO Dep. Order Number DE84011189.

From SPE/DOE/GRI gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

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Detailed analyses of more than 50 core samples of western tight sands have resulted in several unanticipated observations that are set forth in this paper. Core analyses performed under stress representative of producing conditions provided data on porosity, pore volume compressibility, stress dependence of permeability to gas, and slope of the Klinkenberg plot (permeability at constant net stress vs the inverse of pore pressure). Scanning electron microscope (SEM) and petrographic microscope analyses were performed on samples cut from the ends of core plugs tested. The microscopic studies were explicitly directed toward observing the <0.1 micron flow path openings deduced from permeability data. The Computer Operated Rock Analysis Laboratory (C.O.R.A.L.) used for these measurements has been previously described. Permeabilities are measured with a maximum pressure drop of 20 psi, much less than the pore pressure of 100 to 1500 psia. At the one microdarcy level, the standard deviation of sequence of permeability measurements under constant conditions is typically 2% of the measured value. Resolution is a few nanodarcies. The accuracy of porosity measurement is about +- 2% of the reported value, but the sensitivity to pore volume change due to an incremental step in confining pressure is better than 0.1% of the pore volume. Thus, pore volume compressibility is measured to an accuracy of a few percent for a 1000 psi step in confining pressure. The selection of tight sandstone samples for analysis involved an intentional bias. Namely, all samples were from depths that were either known to be gas producers or judged likely to be producers on the basis of wireline log analysis. 9 references, 7 figures, 5 tables.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 25271, 25311, 26151

25335 **(NUREG/CR—3680) Relationship between the gas conductivity and geometry of a natural fracture.** Schrauf, T.W.; Evans, D.D. (Arizona Univ., Tucson (USA). Dept. of Hydrology and Water Resources). Apr 1984. 140p. NTIS, PC A07/MF A01 - GPO* $5.50. Order Number DE84901181.

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In recent years considerable interest in determining the relationship between the hydraulic conductivity of a rock fracture and its average aperture has developed. The present study involved both theoretical and experimental studies of the geometrical factors which influence gas conductivity of rock fractures. Theoretical analysis of parallel plate gas flow revealed that the gas conductivity

of a fracture is the same as for incompressible fluids and can be expected to follow a cubic law relationship. Application of the cubic law to practical field test situations, however, was found to be limited by uncertainties in flow boundary conditions, nonlinearity of flow behavior, and effects of fracture surface roughness. Quantitative assessment of uncertainties in flow boundary conditions including elliptical injection boundaries, secondary intersecting fractures, and estimation of effective radius was performed. Nonlinear flow behavior was also analyzed and the results applied to measurements of gas flow rate through a single natural fracture. Evaluation of these results suggested a general flow equation of the form: $-(dp/dx) = av + bv^2$, where a and b are constant coefficients defined by a fracture's average aperture and surface roughness.

0305 Health And Safety

REFER ALSO TO CITATION(S) 27186

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 25320, 25321, 25322, 26159

25336 **(NP—4900936) Natural gas pricing: an economic analysis of new gas price deregulation with emphasis on the interstate and Texas intrastate markets.** (Texas Governor's Energy Advisory Council, Austin (USA)). 25 Jul 1977. 77p. NTIS, PC A05/MF A01. Order Number DE84900936.

The model uses US and Texas natural gas supply information generated by The Energy Institute at the University of Houston. The demand estimates for natural gas at the wellhead are generated by the Governor's Energy Advisory Council, using price elasticities estimated in noted studies of demand for natural gas and electricity by final consumers. The wellhead demand is determined by first identifying how changing wellhead prices of natural gas affect the delivered prices to different final consumer categories, and then using the estimated price elasticities to determine the change in the quantities demanded by these final consumer categories. The wellhead demand curves are first derived for 1975, based on the elasticity estimates from other studies, and published data on the quantities demanded by each customer class at the delivered prices faced in 1975. The demand curves are then projected forward to each forecast year, under varying assumptions about the growth in the number of consumers in each demand category and the intensity of their use of natural gas. For each year, the supply and demand curves are combined to estimate the market clearing price of new natural gas and the quantities of gas consumed by each customer class. Alternative deregulation cases are examined by modifying the parameters used in projecting demand curves forward to the forecast years. Sixteen separate deregulation cases are examined, representing the possible combinations of four separate policies, each having two positions, under the general heading of new gas price deregulation.

0308 Environmental Effects

REFER ALSO TO CITATION(S) 26924

25337 **(UCRL—88420-Rev.1) Effects of a spill of LNG on mean flow and turbulence under low wind speed, slightly stable atmospheric conditions.** Rodean, H.C. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 11p. (CONF-830802—3-Rev.1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011056.

From International Union of Theoritical and Applied Mechanics symposium on atmospheric disperation of heavy gases and small particles; Delft, Netherlands (28 Aug 1983).

Of the many liquefied natural gas (LNG) spill experiments in the 1980 Burro and 1981 Coyote series at the Naval Weapons Center (NWC), China Lake, California, only one was observed to affect the mean flow and turbulence in the near-surface atmospheric boundary layer. This experiment, Burro 8, was conducted under atmospheric conditions that permitted the gravity flow of the cold, dense gas to be almost independent of the atmospheric boundary layer. The mean flow kinetic energy was damped proportionately more than the turbulent kinetic energy. These effects of the Burro 8 LNG spill were observed at only one instrument station. Three large populations of measured Reynolds stresses are used to demonstrate two data analysis procedures that can lead to an understanding of the physical processes that resulted in the above observations. One involves the use of correlation coefficients to identify active causal links among the Reynolds stresses. The other consists of determining empirical relations among the three invariants of the Reynolds stress tensor. 10 references, 5 figures, 1 table.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 25265, 25306, 25307

25338 **(SAND—83-2563C) Rock mechanics effects observed subsequent to multiple fracturing of wellbores.** Cuderman, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 12p. (CONF-840633—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009066.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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A technique, using propellants, has been developed for producing multiple fractures about a wellbore. The use of propellants having a range of burn rates permits precise control of combustion gas release and thereby of bor-hole pressurization. The pressure rise-time is the key variable gc rning fracture behavior. The peak pressure attained is of secondary importance and appears to be a function of in situ stress and loading rate. The fracture geometry is governed by the in situ stresses. The major fractures occur along the principal planes of stress and along planes of maximum shear stress. 7 references, 7 figures, 1 table.

25339 **(SAND—84-0512C) Determination of in situ stress from anelastic strain recovery measurements of oriented core: comparison to hydraulic fracture stress measurements in the Rollins Sandstone, Piceance Basin, Colorado.** Teufel, L.W.; Warpinski, N.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 11p. (CONF-840633—7). NTIS, PC A02; 3; GPO Dep. Order Number DE84009523.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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A method to determine in situ stress directions and magnitudes from anelastic strain recovery measurements of oriented core has been used to determine the principal horizontal in situ stresses in the Rollins Sandstone in a deep well near Rifle, Colorado. The principal horizontal stress directions were determined directly from the principal horizontal strain recovery directions. The principal horizontal stress magnitudes were calculated from the principal strain recovery magnitudes, overburden stress, and Poisson's ratio of the rock using a viscoelastic model. The accuracy of the in situ stress directions and magnitudes determined from anelastic strain recovery measurements was substantiated by a direct comparison with open-hole hydraulic fracture stress measurements. The anelastic strain recovery method predicted the magnitudes of the maximum and minimum horizontal principal stresses to be 54.5 MPa and 51.9 MPa, respectively; with an azimuth of N63°W +- 8° for the maximum horizontal stress. The hydraulic fracture stress measurements yielded maximum and minimum horizontal principal stress magnitudes of 49.6 MPa and 46.8 MPa, respectively. The azimuth of the maximum horizontal stress ranged from N50°W to N70°W. 17 references, 2 figures, 4 tables.

25340 **(SAND—84-0727C) High energy gas fracturing: a new technique for enhanced gas recovery.** Cuderman, J.F.; Northrop, D.A. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 24p. (CONF-8405111—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84008946.

From American Gas Association natural gas distribution and transmission conference; San Francisco, CA, USA (7 May 1984).

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A technology that uses propellants has been developed to control borehole pressurization so that multiple radial fractures about the wellbore are obtained. The objective is to connect nonintersecting natural fractures in a reservoir to the wellbore and thereby stimulate production. Techniques are presented for specifying the pressure pulse required to produce multiple fractures and for choosing propellants to achieve the desired pressure pulse. The multiple-fracturing technique was developed for application in naturally fractured Devonian-shale gas reservoirs; a stimulation experiment in a Devonian shale gas well successfully increased production from 6700 ft^3/day to 22,000 ft^3/day (190 m^3/day to 623 m^3/day). While the technology was developed for Devonian shale, it should be equally applicable to other oil and gas situations; an application to underground gas storage is presented. 17 references, 10 figures, 1 table.

0320 Transport, Pipelines, And Handling

25341 Vapor spill pipe monitor. Bianchini, G.M.; McRae, T.G. (to Dept. of Energy). US Patent Application 6-507,188. 23 Jun 1983. 12p. Contract W-7405-ENG-48.

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The invention is a method and apparatus for continually monitoring the composition of liquefied natural gas flowing from a spill pipe during a spill test by continually removing a sample of the LNG by means of a probe, gasifying the LNG in the probe, and sending the vaporized LNG to a remote ir gas detector for analysis. The probe comprises three spaced concentric tubes surrounded by a water jacket which communicates with a flow channel defined between the inner and middle, and middle and outer tubes. The inner tube is connected to a pump for providing suction, and the probe is positioned in the LNG flow below the spill pipe with the tip oriented partly downward so that LNG is continuously drawn into the inner tube through a small orifice. The probe is made of a high thermal conductivity metal. Hot water is flowed through the water jacket and through the flow channel between the three tubes to provide the necessary heat transfer to flash vaporize the LNG passing through the inner channel of the probe. The gasified LNG is transported through a connected hose or tubing extending from the probe to a remote ir sensor which measures the gas composition.

0330 Properties

REFER ALSO TO CITATION(S) 25341

0340 Combustion

REFER ALSO TO CITATION(S) 25625

25342 (CONF-811048—Summs., pp 3p, Paper 45) **NO_2 formation in range-top burners.** Coutant, R.W.; Merryman, E.L.; Levy, A. (Battelle, Columbus Labs., OH). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In contrast, NO formation occurs throughout the combustion process and is associated primarily with reactions occurring after the major portion of the hydrocarbon is consumed. In the normal sequence of combustion events, conditions that lead to rapid NO production, i.e., high temperatures and high O-atom concentrations, also reduce the NO_2 formed early in the flame to NO. However, physical structures that thermally quench localized portions of the range-top flame or geometries that permit thermal quenching via rapid influx of secondary air tend to stabilize the NO_2. From a practical viewpoint, increased primary air can be employed to lower both the NO and NO_2 emission factors, especially with pilot flames. The effect of secondary air impingement on exposed flame surfaces should be minimized by minimization of the number of distinct flamelets, or, in the extreme, through the use of a flat-flame burner or screen to effectively produce a broad single flame. (DT)

0350 Storage

REFER ALSO TO CITATION(S) 25340

04 OIL SHALES AND TAR SANDS

25343 (ANL/EES-TM—245) Regional socioeconomic analysis of tar sands development in Utah. South, D.W.; Nagle, J.C.; Nagle, J.W.; Winter, R.C. (Argonne National Lab., IL (USA)). Jul 1983. Contract W-31-109-ENG-38. 436p. NTIS, PC A19/MF A01; GPO Dep. Order Number DE84011534.

This report evaluates the socioeconomic consequences of developing tar sands in nine STSAs in east-central Utah. Effects of tar sands development were examined on several levels: regional, county, census county division (CCD), and community. Effects were projected over the 20-year period from 1985 to 2005 and are described for the five window years of 1985, 1990, 1995, 2000, and 2005. To prepare this analysis, a four-step procedure was followed. First, the existing social and economic conditions of the region were described. Second, conditions were projected for the 20-year period under the assumption that no tar sands resources are developed. Third, the proposed tar sands developments were described. The descriptions included estimates of (1) production levels and (2) the work force required to mine the tar sands and to construct and operate the accompanying retort facilities. Descriptions were prepared for two scenarios; one assumed a high level of tar sands development and one a low level of development. Fourth, the impacts of these developments were projected for the 20-year period and each of these impacts was analyzed. In addition to tar sands development, the development of other energy resources (such as oil shale and coal) in the same Utah region was examined. The socioeconomic impacts of these developments were estimated and added to the impacts of the tar sands developments. Two socioeconomic models were used to collect and analyze data. The types of effects examined include: impacts on population; number of households; employment; wages; per capita income; and elements of the public and private infrastructure such as housing, education, health care, and utilities. Because the Uintah and Ouray Indian Reservation takes up a large part of the area that was studied, effects on it were also examined. 55 figures, 48 tables.

25344 (SAND—83-2403, pp 5-26) **Fossil energy: oil shale R & D program.** Ramsey, J.W. (Dept. of Energy, Washington, DC). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

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Visual aids are presented for the Department of Energy's oil shale research and development program. The following topics are covered: historical aspects of oil shale; constraints related to present oil shale technology; oil shale research and development program thrusts/redirection; major research and development problems; program direction and strategy; oil shale program; oil shale budget; key components and interrelationships of the oil shale program; FY 1983 oil shale program; and union project.

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 25372

25345 (SAND—83-2403, pp 425-456) **Fracture modeling: overview, theory and oil shale calculations.** Adams, T.F.; Keller, C.F. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The description of fracture that is implemented in our SHALE computer code is a microphysical model. It has three elements: a mechanical model, a statistical description, and expressions for the effective elastic moduli. The material is considered to be an elastic matrix with embedded cracks or flaws. Crack stability is

governed by a generalized Griffith criterion. The initial distribution of flaws is assumed to be exponential, and the statistical treatment allows for the growth of cracks larger than some minimum size. The effective elastic moduli come from the solution for an isolated crack in an elastic medium. Strain rate and size effects follow naturally from the theory, and calculated fracture stresses agree well with dynamic fracture data. SHALE is our state-of-the-art solid mechanics code. The 2-D version is operational, and a 3-D version is under development. The code integrates the mass, momentum, and energy conservation equations. The results of the calculations include time histories of quantities such as stress and velocity, and the predicted extent and intensity of fracture. 26 figures.

25346 (SAND—83-2403, pp 457-490) **Engineering models of fragment motion for evaluating rubbling designs.** Schamaun, J.T. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

This presentation discusses the fragment motion of fractured rock during rubblization of in situ oil shale retorts. The definition and importance of the fragment motion phase is discussed. Three numerical models used to calculate fragment motion are presented along with examples of their use. 30 figures.

25347 (SAND—83-2403, pp 491-504) **History of LANL rock fragmentation field experiments.** Edwards, C.L. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

As part of the US Department of Energy (DOE) Oil Shale Fragmentation Program, during the period 1978 through 1980, the Los Alamos National Laboratory conducted 19 single and multiple borehole cratering experiments at the Colony Oil Shale Mine near Parachute, Colorado. Subsequently, Los Alamos, in conjunction with Science Applications, Inc. (SAI), participated in an extensive program of explosive rubbling experiments at the DOE oil shale mine at Anvil Points, Colorado. An additional 275 small-scale experiments (less than 10 g of explosive) were performed in the laboratory and in the Colony and Anvil Points mines. The purpose of these experiments was to evaluate scaling as a tool to infer the behavior of large-scale tests from small-scale experiments, to calibrate the hydrodynamic computer codes used to model explosive fragmentation of oil shale, and to investigate the influence of bedding plane orientation, natural joints, fractures, and the grade of oil shale on rock fragmenation. 7 figures.

25348 (SAND—83-2403, pp 505-518) **Observations and results from recent field experiments.** Craig, J.L. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

During the week of May 15, 1983, three experiments were conducted by Los Alamos National Laboratory. These experiments were conducted in Adit 3 of the Anvil Points Demonstration Mine. The three experiments were designed to provide Sandia National Labs with a reasonable stemming design to use in the Sandia SB Series. The stemming was required to essentially hold an explosive for approximately 30 ms. The three tests were labeled 83-A, 83-B, and 83-C. 83-A and 83-B were designed at 5 m depth with 2.5 m of explosive and 2.5 m of stemming. A layer of wet clay was inserted between the explosive and the stemming. 83-C was designed to be 3 m depth with 1.5 m stemming and 1.5 m explosive. The wet clay barrier was also inserted in this experiment. All tests performed as expected and data retrieval and reduction was done with only minor problems in gauge sensitivity and response discovered. Further reduction and analysis is continuing and will be presented at a later date. 7 figures.

25349 (SAND—83-2403, pp 549-558) **Goals of the present rock fragmentation program and instrumentation.** Dick, R.D. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The major goals of the Los Alamos National Laboratory's Rock Fragmentation Program are (1) obtain quantitative data on the rubblization process to verify and calibrate the computer models and lead to a realistic computer model for future field experiments; (2) provide a realistic computational code to assist in identifying phenomenology important to the fragmentation process in geologic materials, specifically oil shale, (3) eventually provide a rubble bed for conducting gas flow and tracer experiments in an in situ retort design for oil shale; and (4) develop a more versatile instrumentation capability to provide the needed data. At the present time, the Los Alamos fragmentation program has concentrated on the rubblization of oil shale, but the methods can be applied to other geologic materials of interest. 5 figures.

25350 (SAND—83-2403, pp 559-562) **Oil shale fragmentation research at Los Alamos.** Morris, W.A. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The Los Alamos National Laboratory is involved in basic rock fragmentation research needed for the bed preparation design of a modified in situ retort. The retort bed must have uniform particle size, permeability, and void distributions to allow proper retorting and optimum resource recovery. We are studying controlled fracturing using chemical explosives and carefully designed blasting schemes to attain this distribution. Our approach to the bed preparation problem is a coordinated research program of explosives characterization, predictive computer modeling, and field verification tests. The program is designed to develop the predictive fracturing capability required for the optimum rubbling of the shale. It takes advantage of the large computing facilities at Los Alamos and the considerable expertise in explosive and computer hydrocodes developed here for other energy and national defense programs.

25351 (SAND—83-2403, pp 563-588) **DOE joint experimental rock fragmentation research program.** Parrish, R.L. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The DOE joint rock fragmentation program was formulated to achieve a fundamental understanding of the total rubblization sequence. The experimental program included participation in 1982 in the SAI-Consortium program at Anvil Points. A joint DOE, Los Alamos National Laboratory, Sandia National Laboratory program, beginning in FY83, is directed specifically toward acquiring data to develop and verify analytical models. Emphasis is being placed on instrumentation and data acquisition in sufficient detail to obtain well-defined quantitative measurements during both the rock fragmentation and rock motion time regimes, with particular emphasis on the rock motion measurements. The first phase of this test program consists of four categories, grouped by geometry and specific purpose: preliminary explosive and stemming performance tests, single borehole cratering tests, multiple borehole timing and spacing evaluation tests, and multiple borehole, single deck fracturing tests. The preliminary explosive/stemming evaluation tests and single borehole cratering tests are in progress; the remaining tests will be conducted in subsequent years. 21 figures.

25352 **(SAND—83-2678C) Development of a predictive capability for oil shale rubblization: result of recent cratering experiments.** Parrish, R.L.; Kuszmaul, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 17p. (CONF-8404121—3). NTIS, PC A02; 3; GPO Dep. Order Number DE84010304.

From 17. oil shale symposium; Golden, CO, USA (16 Apr 1984).

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Sandia National Laboratories conducted two heavily instrumented single borehole cratering tests during 1983 at the Anvil Points Mine. These tests, one stemmed and one unstemmed, were executed expressly to provide baseline data for correlation with existing rock fragmentation models, to provide input for the development and verification of rock motion models, and to investigate the

effect of minimum gas pressure on rubblization. An extensive array of embedded sensors was employed to obtain diagnostic and response measurements. Photometric coverage with high speed framing cameras, monitoring anchored target movement, provided independent measurements of rock motion. Rubble excavation and screening provided data on crater volumes and shapes, void percent, and fragment size distribution. Diagnostic measurements verified satisfactory and repeatable explosive and stemming performance. Crater depths and volumes were less than predicted and nearly equal for the stemmed and unstemmed tests. The particle size distributions were almost identical. The detonation-induced stress wave amplitudes and initial velocity changes were essentially the same. Rock motion measurements from sensor and photometric data compared favorably. Post-test calculations, using a finite element program, DYNA2D, compared well with early-time response measurements. Later-time rock motion data are being used in the development of discrete element programs, BLOCKS and BUMP. Use of the experimental data in the development of these models is discussed, along with comparisons of BLOCK model calculations with experimental results. These comparisons indicate that the BLOCKS model simulates later-time rock motion adequately. 16 references, 31 figures.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 25298, 25312, 25346, 25347, 25349, 25350, 25351, 25352, 26529

25353 **(DOE/ET/14371—T1) Vacuum process for recovery of oil from oil shale.** Oldfield, S.L.; Wiberley, S.E. . (Rensselaer Polytechnic Inst., Troy, NY (USA)). 1984. Contract AC01-80ET14371. 138p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84010471.

A unique oil shale retorting method which operates at low pressures (5 to 10 torr) was developed. Investigations were conducted on one to five gram samples in a laboratory bench-scale reactor to determine the optimum retorting parameters. To demonstrate the feasibility of the method on a larger scale, experiments were carried out on a prototype reactor capable of processing 22 kg of shale in five hours. Initial studies of Green River Formation shale showed that the optimum yields of oil and high heating value gases were obtained at a retorting temperature of 420°C to 450°C and a residence time of one hour. Five gram samples of six grades of shale, ranging from 12 to 68 gal/ton were processed, and oil yields of 80 to 90% of the Fischer assay were achieved. Eastern shales were also processed in the benchscale unit, and oil yields of up to 200% of the Fischer assay and a high heating value gas were obtained at a retorting temperature of 400°C. Retorting eastern oil shale in 200 torr of helium or 200 torr to 650 torr of hydrogen yielded less oil than retorting at a pressure of 0.1 torr. Oil yields of 92 to 97% of the Fischer assay were obtained from western shale in the prototype reactor at a temperature range of 340 to 375°C and 110% at 425°C. For an eastern shale, the oil yield was 114% of the Fischer assay. Western shale oils obtained from vacuum retorting are similar in composition and properties to shale oils obtained from other retorting methods. Eastern oils from vacuum retorting contain less nitrogen and have lower pour points than western shale oils, but have higher sulfur and aromatic contents. High Btu gases are obtained from the vacuum processing of both western and eastern shales. The gas from western shale contains more carbon dioxide while the gas from eastern shale contains more carbonyl sulfide and sulfur dioxide. 27 references, 34 figures.

25354 **(DOE/LC/10787—126) Investigation of the geokinetics horizontal in situ oil shale retorting process. Quarterly report, October, November, December 1983.** Henderson, K.B. (Geokinetics, Inc., Salt Lake City, UT (USA)). Mar 1984. Contract FC20-78LC10787. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011125.

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Retort No. 27 was ignited on August 11, 1983 and by December 31 had completed 139 days of operation and produced 11,420 barrels of oil. Retort No. 28 was ignited on October 18, 1983 and on December 31 had completed 74 days of operation and produced 5,285 barrels of oil. The off-gas processing plants for the two retorts was completed and put through a shakedown run. Concentration levels of H_2S and NH_3 in the retort off gas did not warrant plant operation in the fourth quarter. Environmental studies are reported.

25355 **(NERDDP-EG—81-19) Julia Creek project: shale oil refining investigation.** Mandelson, J.J. (Department of Resources and Energy, Canberra (Australia)). Jun 1981. 261p. Department of Resources and Energy, Canberra, Australia.

Discusses the technology and capital operating costs of refining Julia Creek shale oil into transport fuels. The continuous pilot oil shale retort at CSR Research Laboratories, Roseville, New South Wales, Australia is examined as a means of producing shale oil. The assaying of shale oil in the laboratories of UOP Inc. Des Plaines, Illinois, USA is discussed. The proposing and costing of oil refining schemes based on current petroleum technology are examined.

25356 (SAND—83-2403, pp 29-42) **Review of 10 and 150 ton LETC oil shale retort programs prior to 1976.** Martel, R.A. (Univ. of Wyoming Research Corp., Laramie). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

For over 30 years the Laramie Energy Technology Center has been actively engaged in oil shale technology research specifically to study various scenarios of oil shale conversion to some type of usable liquid product. One technique which appeared to have significant economic and environmental advantage over others was in situ retorting. Whether true (borehole access) or what later evolved and was known as modified in situ retorting would apply depended on a number of factors. In either case, successful recovery of substantial quantities of oil from a fractured mass of oil shale depended largely upon permeability, particle size distribution, the degree of control that could be maintained in directing the retorting front and the uniformity of the rate of advance of the front. To simulate in situ retorting conditions, an experimental aboveground retort with a nominal capacity of about 10 tons was put into operation by the United States Bureau of Mines at the Laramie Energy Technology Center in January 1965. Later a larger retort of 150 tons capacity was developed and put into operation, and both retorts were used to study different aspects of the in-situ retorting problem. The conclusion is that comparable oil recoveries could be realized in both retorts but only at different operating conditions. 2 references, 9 figures.

25357 (SAND—83-2403, pp 43-100) **Modified in-situ retorting: review of past R & D at LLNL.** Campbell, J.H. (Lawrence Livermore National Lab., CA). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Over the past several years, Lawrence Livermore National Laboratory (LLNL) has carried out extensive research and development on modified in situ (MIS) recovery of oil shale. One of the major goals of the LLNL program has been to provide fundamental information about the MIS retorting process. To achieve this goal we have set up a three-part integrated program of: laboratory bench-scale experiments; mathematical modeling; and simulated MIS pilot retorting experiments. Oil Shale Laboratory Research: a brief review is presented of studies on the chemistry of oil shale retorting. Emphasis is placed on the kinetics for oil production and distribution mechanisms including kerogen-bitumen pyrolysis, oil coking and oil cracking. Mathematical Modeling of MIS Retorts: a one-dimensional retort model has been developed at LLNL and used to compare with data form the two Livermore Pilot retorts. In general, the model predictions have been found to agree well with the pilot retort results. Pilot Retort Experiments: experiments designed to simulate various MIS retorting conditions have been carried out in LLNL's large (6 tonne) and small (125 kg) pilot retorts. Both retorts were operated adiabatically using a system of computer controlled sidewall heaters. 44 figures, 2 tables.

25358 (SAND—83-2403, pp 103-114) **True in-situ recovery of shale oil.** Merriam, N.W. (Univ. of Wyoming Research Corp., Laramie). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

True in-situ recovery is defined as recovery in place, and means mining is not used in the recovery process. Organizations known to have conducted true in-situ oil shale recovery tests include: Sinclair (Arco), Equity, Shell, Laramie Energy Technology Center, Geokinetics, Dow, Talley, Texaco and Illinois Institute of Technology Research Institute. Sinclair (Arco) tested combustion in pneumatically created fractures at a depth of 300 feet in the Mahagany Ledge in 1953-1954 near Grand Valley, Colorado. The test burned for five days, experienced a decline in the air injection rate as the shale was heated, and produced a small amount of oil. Equity Oil Company tested hot methane circulation between wells spaced at 500 feet in a naturally porous zone in Rio Blanco County, Colorado in 1965. Some light oil was recovered. Steam injection was tested in 1970. In the most recent test, steam was injected into the leached zone from 1978 to 1981. The test produced 1200 barrels of shale oil, while achieving the injection rates and uniformity of heating set out as objectives. Laramie Energy Technology Center tested fracturing and retorting from 1965 to 1979 at sites near Rock Springs, Wyoming. Most work was done in the Tipton Member of the Green River Formation at depths of 40 to 200 feet. Fracturing tests used electrolinking, hydraulic fracturing, wellbore blasting, slurry explosive blasting in hydraulic fractures, and combinations of those. 9 figures.

25359 (SAND—83-2403, pp 115-124) **Occidental Oil Shale, Inc., introduction and background.** Harak, A.E. (Energy Engineering and Management Services, Inc., Laramie, WY). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The Department of Energy's cost sharing cooperative agreement with Occidental Oil Shale, Inc. (OOSI) began in November 1976 and ended in August 1981 - a period of 5 years and 10 months. The total cost of the agreement during that period was $105,534,000; the government's share was $37,814,000 or 35.8 percent. This cooperative agreement was a two phase research effort to rubble and process large Vertical Modified In Situ (VMIS) retorts at OOSI's Logan Wash Site in western Colorado. Phase I included the processing of retort No. 5 (previously rubbled at OOSI's expense) and to mine, rubble and process retort No. 6. Phase II consisted of rubbling four small retorts, and the mining, rubbling and processing of two large commercial sized retorts (7 & 8). The primary objective of this research effort was to gather technical, environmental and design data for the VMIS process that could be applied to OOSI's C/sub b/ lease tract to develop a commercial scale oil shale facility there. 6 figures.

25360 (SAND—83-2403, pp 125-136) **Geokinetics, Inc., introduction and background.** Harak, A.E. (Energy Engineering and Management Services, Inc., Laramie, WY). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The Department of Energy's Cost Sharing Cooperative Agreement with Geokinetics began in November 1976 and is continuing. The total cost of the agreement to date is approximately $15,458,000; the government's share is $13,435,000 or 86 percent. This cooperative agreement is a four phase (Phases III through VI) agreement to develop and improve shale oil recovery techniques through the use of horizontal in situ retorts. The Geokinetics' research site is located about 70 miles south of Vernal, Utah. There, a 30 foot layer of rich oil shale lying under 20 to 100 feet of overburden is the target resource. Retorts are formed by drilling a pattern of blastholes into the oil shale formation from the surface. The holes are then loaded with explosives and fired using a carefully designed timing system. The resulting highly permeable mass of oil shale is then retorted by igniting the shale along one edge of the rubbled zone. After ignition, air or air plus other gases are blown into the retort to advance the flame front horizontally. During this multi-phase program, retorts of increasing size ave been fractured and subsequently retorted. From 1976 to date, 18 retorts have been rubbled and 14 have been processed or burned to produce shale oil. Early retorts during Phases III and IV were small with a maximum of about 46,000 tons of shale being rubbled per retort. The last retorts rubbled (Nos. 27 and 28) are each about 2 acres in size and contain some 200,000 tons of broken shale per retort. 5 figures, 2 tables.

25361 (SAND—83-2403, pp 137-166) **Sandia/Geokinetics retort 23: a horizontal in situ retorting experiment.** Tyner, C.E. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Sandia National Laboratories and Geokinetics, Inc. have recently completed processing of a 6000 tonne horizontal in situ oil shale retort near Vernal, Utah. The heavily-instrumented, explosively-fractured oil shale bed, containing 12% void, was combustion retorted using a number of different process operating conditions, including air at high and low flow rates and air plus 30% combusted recycle gas. A number of techniques were used to evaluate the effectiveness of thes various processing modes. The experiment demonstrated that true in situ retorting of thin-seam rubbled shale beds with low void volume is practical using horizontal burn techniques and that existing retort diagnostics are capable of providing a detailed analysis of the process. 4 references, 23 figures, 1 table.

25362 (SAND—83-2403, pp 167-184) **Vertical modified in situ retorting occidental retort 6, mini-retorts.** Hommert, P.J. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

As part of the DOE program to develop technology for in situ oil shale processing, Sandia National Laboratories has been involved in the instrumentation and evaluation of a number of in situ retorting experiments. It was identified early in this field effort, that in addition to instrumentation, it would be necessary to have a means to estimate from the offgas flow and product composition the amount of shale being retorted and the local yield losses. To this end a material balance procedure was developed that utilizes key constituents in the offgas and the total product flow rate to estimate retorted shale and the amount of oil lost to combustion, coking, and cracking. This easy to use technique has been calibrated by using the data base developed from the L runs conducted by the Lawrence Livermore Laboratories. The technique has been applied successfully on a number of field experiments at Geokinetics and Occidental. 14 figures.

25363 (SAND—83-2403, pp 185-198) **Rio Blanco vertical modified in situ retorting.** Campbell, J.H. (Lawrence Livermore National Lab., CA). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

25364 (SAND—83-2403, pp 199-252) **Analysis of occidental vertical modified in situ retorts No. 7 & No. 8.** Bickel, T.C. (Sandia National Labs., Albuqerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Sandia National Laboratories participated with Occidental Oil Shale, Inc., in the processing of vertical modified in situ (VMIS) Retorts 7 and 8. These retorts were extensively instrumented, commercial size retorts (50 m x 50 m x 75 m) that were processed concurrently at Occidental's Logan Wash site near Debeque, Colorado. Retorts 7 and 8 each contained ~ 340,000 tonnes of rubble with rubble voids of ~ 18.5%. Average shale grade was 71 l/tonne (17.0 gpt). Energy balance calculations (using the combined results of the material balance calculations and the thermal data) indicate ~ 30% of the available energy of the raw kerogen was combusted to produce shale oil, low BTU gas and C_5-C_{12} hydrocarbons. The fuel source for the combustion energy was mostly oil (~ 66%), while char and gas accounted for the remainder. Oxygen uti-

lization (a measure of how well combustion energy is utilized in the retorting of shale) was 0.33 and 0.37 kg shale retorted/mole O_2 injected for Retorts 7 and 8, respectively, indicating excellent energy utilization in both retorts. 45 figures, 2 tables.

25365 (SAND—83-2403, pp 255-260) **Sandia National Laboratories program for in situ oil shale research.** Hommert, P.J. (Sandia National Labs., Albuqerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Work at Sandia is directed at developing a predictive capability for in situ oil shale processes. This implies the ability to predict important features of retort operation as a function of key design parameters and actual operating conditions. This goal includes the capability to study parametrically the effects of changes in either retort design, construction (especially including blasting) or operation on retort efficiency and production. Through the research that has been conducted since the early seventies, several key areas in need of a more fundamental understanding have been identified. In particular, there is not presently the capability to quantitatively relate changes in blast design parameters to the permeability and particle size distributions produced during a blast. It is clear, however, that permeability and particle size distribution are the most significant parameters controlling eventual retort yield. Furthermore, once a permeability structure has been established the capability does not presently exist to predict how permeability contrasts will affect retort yield. Thus, future research will focus on the two areas of a more fundamental understanding of bed preparation via explosive fragmentation and the development through appropriate experimentation and modeling of multi-dimensional models that relate bed properties to retort yield. Once the tools described above have been developed, it will be possible to utilize the design evaluation scheme.

25366 (SAND—83-2403, pp 261-280) **Permeability contrast effects on in situ oil shale retorting efficiency.** Tyner, C.E.; Cook, D.W. (Sandia National Labs., Albuqerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

To distinguish oil yield loss mechanisms caused by non-uniform permeability distributions in an oil shale retort rubble bed from those caused by other factors (particle size, grade, or operating conditions), we have conducted a series of 100-kg adiabatic pilot retorting experiments with deliberate axisymmetric permeability contrasts introduced during bed loading as the only variable. We have observed, as a function of increasing contrast between the permeability of the two zones in the retort, increasing delays in heating (and thus retorting) within the lower-permeability zone. This results directly in increased oil combustion and cracking losses ($\sim$ 20% versus $\sim$ 5% for a uniform base case) because of increased overlap of retorting and combustion zones. We have also observed under these conditions corresponding decreases in thermal efficiency (with the resulting energy left primarily as increased sensible heat in the shale after completion of retorting) and char utilization. These data have conclusively demonstrated heat local yield losses (not just sweep inefficiencies) can be introduced solely by permeability contrasts. 1 reference, 15 figures, 1 table.

25367 (SAND—83-2403, pp 281-316) **Multidimensional tracer flow and oil shale retorting models.** Travis, B.J.; Hodson, S.W. (Los Alamos National Lab., NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Mathematical models of geochemical processes, when developed in conjunction with sound experimental programs, can provide powerful tools for unraveling the sometimes complex interplay of physical and chemical forces. We describe in this presentation several computer models that we use for modified in situ (MIS) oil shale retort analyses. Our models were developed to answer two questions: (1) what distribution of porosity and permeability was actually achieved by a rubbling process at a particular site; and (2) how do spatial non-uniformities in porosity, permeability, rubble size, etc., affect retort oil yield. 28 figures.

25368 (SAND—83-2403, pp 317-340) **Experimental tracer tests on LETC 150 ton retort.** Romero, C.A. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The use of gaseous tracers has long been considered a viable method of characterizing the structure of a porous medium. The application considered here is to vertical modified in situ (VMIS) retorting of oil shale. A steady flow of air is initiated across the retort. A gaseous tracer is injected into the bed and the response as a function of time is measured at various sample points within the rubble. The dynamic responses contain information from which various characteristics of the porous medium can be deduced (such as local permeabilities, particle sizes, etc.). Such information is of critical importance to provide immediate feedback on the effects of a variation in blasting parameters on the resulting rubble structure. Without this tool, the optimization of rock fragmentation techniques must proceed somewhat blindly; that is, without the aid of accurate information on the outcome of tests. This provides incentive for developing the tracer technology. Before tracers can become routine diagnostic tools, the following must be completed: (1) optimize techniques so that repeatable, reliable data are obtained; and (2) correlate experimental data with theoretical codes. Recent experiments at UWRC's (formerly LETC) 150 ton retort in Laramie focused on quantifying the accuracy with which a non-uniform medium can be described from tracer data. Results indicate that high spatial resolution was needed to distinguish the obstruction from the rubble. In a commercial size retort, such resolution may not be economically feasible. 4 references, 17 figures, 1 table.

25369 (SAND—83-2403, pp 341-352) **Low void retorting.** Martel, R.A. (Univ. of Wyoming, Laramie). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

There are potentially billions of cubic meters of liquid hydocarbon available from oil shale of the Piceance Creek basin of western Colorado. This region is amenable to exploitation by a concept known as Vertical Modified In Situ (VMIS) combustion retorting. Field tests have been conducted with initial void volumes ranging from 20 to 40%. However, low void rubbling technology has met with only limited sources in the field. The low void retort is designed to test different retorting parameters for rubble and fracture conditions in the range of 8 to 18% void volume. From the work to date, it can be stated that oil yields at 12% void are at least as good as results from similar non-adiabatic retorts at 50% void. Particle size seems so far to have the only effect on yield. The present status of the low void retorting program is taht it is proceeding to establish a data base under the auspices of the University of Wyoming Research Corporation. 1 reference, 7 figures.

25370 (SAND—83-2403, pp 353-368) **10 ton retort tracer tests.** Turner, T.F. (Univ. of Wyoming, Laramie). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The objective of the tracer program at the University of Wyoming Research Corporation (UWYRC) is to reduce the cost and effort involved in characterizing the flow in a modified in situ oil shale retort. This objective is being approached in three ways. First, UWYRC is conducting extensive tracer testing on both the 150 ton and 10 ton retorts north of Laramie. In the 150 ton retort, Sandia Labs and UWYRC teams just completed a series of tests to study flow around an impermeable object. The 10 ton retort is being used to study flow channeling and its effect on tracer response curves, steam front movement, and oil yield. The second method involves the development of remote release tracer canisters which can be placed in a retort during blasting and then activated at a later time. These canisters could reduce the need for mining instrumentation access drifts around a retort. The third approach is to help in developing tracer models that aid in understanding and implementing the properties of a retort rubble bed. Current work is aimed at implementing and checking the code developed by Brian Travis at Los Alamos National Labs. The latest series of 10 ton retort runs have been designed to study the effect of changes in

sweep efficiency on tracer response and on yield loss. It is hoped that from these tests a correlation can be made between an inlet-to-outlet tracer response curve and both sweep efficiency and yield loss. If this proves possible, then we will have the diagnostic test needed. 2 references, 10 figures.

25371 (SAND—83-2403, pp 371-424) **Fracturing for true in situ and near-surface true in situ processes.** Parrish, R.L. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

The Laramie Energy Technology Center, over a period of years, conducted, directed and/or monitored a series of field experiments to evaluate the technical and economic feasibility of true in situ oil shale processing. This presentation reviews those experiments in which the bed preparation technique was explosive fracturing; (deep) true in situ experiments conducted at the DOE field laboratory near Rock Springs, Wyoming, and near-surface true in situ experiments conducted by Geokinetics, Inc. in Uintah County, Utah. The DOE-conducted true in situ fracturing experiments consisted of variations of two basic methods, wellbore springing and hydraulic/explosive fracturing. In these deeper (> 100 ft. of overburden) shale beds, the quasi-void generated for rubblization must be achieved basically by compression of the adjacent shale. One experiment of each type is discussed as an example of typical results and the inherent problems associated with the techniques. 24 figures.

25372 (SAND—83-2403, pp 519-546) **Results of recent field experiments at Anvil Points.** Parrish, R.L. (Sandia National Labs., Albuquerque, NM). Feb 1984. NTIS, PC A19/MF A01. (CONF-830684—).

From In situ oil shale conference; Albuquerque, NM, USA (7 Jun 1983).

Vertical modified in situ (VMIS) fracturing tests were conducted by Science Applications, Inc. (SAI) at the Anvil Points Mine from July 1981 through July 1982 as part of a rock fragmentation project sponsored by a consortium of six oil companies. The test series advanced from single borehole cratering tests through small scale retort fracturing tests. Sandia provided instrumentation and photometric coverage on the top level of two small scale retort fracturing tests; we also provided limited instrumentation on other special tests. This presentation reviews the instrumentation and data acquisition/reduction techniques used and some of the measurements obtained. Emphasis is placed on special techniques employed to obtain rock motion measurements. 22 figures.

25373 **(SAND—83-2603C) Oil yield losses in non-uniform in situ oil shale retorts.** Tyner, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 19p. (CONF-8404121—4). NTIS, PC A02; 3; GPO Dep. Order Number DE84010303.

From 17. oil shale symposium; Golden, CO, USA (16 Apr 1984).

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Oil yield losses within an in situ oil shale retort can be categorized as either sweep inefficiencies or local yield losses. It is well established that rubble bed non-uniformities can contribute directly to sweep inefficiencies. However, the high local yield losses observed in recent field tests have suggested that these nonuniformities may also decrease local oil yield through increased oil coking, cracking, and combustion. To distinguish oil yield loss mechanisms caused by non-uniform permeability distributions from those caused by other factors (particle size, grade, or operating conditions), a series of pilot retorting experiments was conducted with permeability contrast as the only experimental variable. In these experiments we observed, as a function of increasing permeability contrast, increasing delays in heating (and thus retorting) within the less-permeabl zones. This resulted directly in increased oil combustion and cracking losses (11 to 23% versus 5% for a uniform base condition) due to increased overlap of retorting and combustion fronts. We also observed under these conditions corresponding decreases in thermal efficiency and char utilization. Finally, two-dimensional retort modeling calculations have been completed which agree well with the experimental results and help illuminate the important mechanisms causing increased oil loss. These data, together with analyses from recent field experiments, have demonstrated conclusively that local oil yield losses (not just sweep inefficiencies) can be introduced or worsened solely by permeability contrasts. Conversely, it appears that local yield as well as sweep efficiency may be significantly improved by creating more uniform rubble beds. 18 references, 20 figures, 5 tables.

25374 **Simultaneous fluid-solid reactions in porous solids. II. Reactions between one fluid and two solid reactants.** Sohn, H.Y.; Braun, R.L. (Lawrence Livermore National Lab., CA). *Chemical Engineering Science;* **39**: No. 1, 21-30(1984). Contract W-7405-ENG-48.

A general model describing simultaneous independent reactions between one fluid reactant and two solid reactants is presented. Such reaction systems are attracting much attention in the areas of oil shale retorting, reduction of mixed metal oxides with a reducing gas, leaching of mixed minerals, and roasting of mixed sulfides. The model has been formulated in general terms so as to allow the incorporation of specific details of an actual system. The law of additive reaction times previously developed for single fluid - solid reactions and found useful for the analysis of the reaction between one solid and two fluid reactants has been applied to the reaction system under consideration. It has yielded a useful approximate solution, which obviates the necessity for repeated numerical solution of a second-order differential equation with split boundary conditions and removes the possibility of encountering the numerical stiffness problem.

25375 **Combustion heater for oil shale.** Mallon, R.; Walton, O.; Lewis, A.E.; Braun, R. (to Dept. of Energy). US Patent Application 6-534,427. 21 Sep 1983. 16p. Contract W-7405-ENG-48.

A combustion heater for oil shale heats particles of spent oil shale containing unburned char by burning the char. A delayed fall is produced by flowing the shale particles down through a stack of downwardly sloped overlapping baffles alternately extending from opposite sides of a vertical column. The delayed fall and flow reversal occurring in passing from each baffle to the next increase the residence time and increase the contact of the oil shale particles with combustion supporting gas flowed across the column to heat the shale to about 650 to 700°C for use as a process heat source.

25376 **Process for oil shale retorting using gravity-driven solids flow and solid-solid heat exchange.** Lewis, A.E.; Braun, R.L.; Mallon, R.G.; Walton, O.R. (to Dept. of Energy). US Patent Application 6-534,472. 21 Sep 1983. 36p. Contract W-7405-ENG-48.

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A cascading bed retorting process and apparatus are disclosed in which cold raw crushed shale enters at the middle of a retort column into a mixer stage where it is rapidly mixed with hot recycled shale and thereby heated to pyrolysis temperature. The heated mixture then passes through a pyrolyzer stage where it resides for a sufficient time for complete pyrolysis to occur. The spent shale from the pyrolyzer is recirculated through a burner stage where the residual char is burned to heat the shale which then enters the mixer stage.

25377 **Improved solvent recovery of Eastern shale oil.** McKay, J.F.; Chong, S.L. (to Dept. of Energy). US Patent Application 6-509,557. 30 Jun 1983. 14p.

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An improved process is disclosed for solvent extraction of organic matter from Eastern shale by two extraction steps in sequence. The extraction steps are: (a) treating an Eastern kerogen-containing shale with a solvent system comprising a combination of water and tetralin at a temperature of about 375° to 425°C; and (b) treating the product of (a) with a solvent system comprising a combination of an alcohol and another organic solvent at an elevated temperature, but not above about 425°C. The organic matter is recovered by separating the liquid which results from step (b) from the shale solids.

25378 **Staged fluidized bed.** Mallon, R.G. (to Dept. of Energy). US Patent Application 6-494,236. 13 May 1983. 14p. Contract W-7405-ENG-48.

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The invention relates to oil shale retorting and more particularly to staged fluidized bed oil shale retorting. Method and apparatus are disclosed for narrowing the distribution of residence times of any size particle and equalizing the residence times of large and small particles in fluidized beds. Particles are moved up one fluidized column and down a second fluidized column with the relative heights selected to equalize residence times of large and small particles. Additional pairs of columns are staged to narrow the distribution of residence times and provide complete processing of the material.

0405 Properties And Composition

25379 (LBL—13500, pp 1.23-1.26) **Molecular substituent parameters applied to the specification of inorganic arsenic and organoarsenic compounds in shale oil and oil shale kerogen by HPLC-GFAA.** Fish, R.H.; Brinckman, F.E.; Weiss, C.S. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25380 **(NP—4901139) Reactivity of spent Chattanooga Oil Shale.** McKinley, M.D.; Lin, Y.C. (Alabama Univ., University (USA). School of Mines and Energy Development). Oct 1983. 148p. NTIS, PC A07/MF A01. Order Number DE84901139.

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This work describes the reactivity of the char residue in spent Chattanooga Oil Shale. The process scheme investigated was a two-step process. The first step in the process was a pyrolysis (or retorting) process in which experiments were conducted at five different heating rates using a thermogravimetric method. The second step began after a period of temperature soaking and involved the gasification of the carbon in the spent shale from the pyrolysis process. A sample of oil shale obtained from an outcrop of Devonian Shale near New Market in Madison County, Alabama, ground to (-150+200 and -100+150 US mesh), was used in this investigation. The effects of particle size, heating rate during pyrolysis, temperature, and gas environment on the weight loss of the oil shale were studied. A Fischer Thermal Analyzer was used to determine the reactivity of the spent shale at atmospheric pressure to oxygen in an air/N_2 mixture and to CO_2. Reaction temperatures were from 700 to 1080 K. It was found that the reactivity of this shale increased with increasing heating rate during pyrolysis up to a heating rate of 10°C/min, beyond which it started decreasing. It was also found that the reactivity of this shale increased with increasing temperature within the experimental range studied. Furthermore, the particle size of -150+200 US mesh was more reactive than the -100+150 US mesh size. The oxidation reactions between residual char and air were consistent with zero order reaction with respect to carbon and first order reaction with respect to oxygen content in the gas. The activation energy in air for -150+200 US mesh was found to be 17,600 cal/mole, a value comparable with the literature for other oil shale. The unreacted-core-shrinking model was found to give a good fit to the kinetic data collected in this experimental work. 58 references, 33 figures, 16 tables.

25381 **Relaxation behavior in the carbon-13 nuclear magnetic resonance spectrometric analysis of kerogen with cross polarization and magic-angle spinning.** Palmer, A.R.; Maciel, G.E. (Colorado State Univ., Fort Collins). *Analytical Chemistry;* **54**: No. 13, 2194-2198(Nov 1982).

A detailed study is reported on the relaxation behavior pertinent to the ^{13}C NMR analysis of a Colorado kerogen concentrate, using cross polarization (CP) and magic-angle spinning (MAS). The desired condition T/sub CH/ < contact time <T/sub 1pH/, T/sub 1pC/ was found to hold, indicating a good prognosis for the ^{13}C CP/MAS analysis of kerogen. The $_{13}C$ spectrum obtained with a contact time of 1 ms is in agreement with that obtained from a Bloch-decay experiment. ^{13}C T_2 data and two-dimension FT experiments indicate that inhomogeneous broadening influences, e.g., chemical shift distributions, are the largest contributors to the ^{13}C line widths in the spectrum. Resolution-enhancing apodization methods and differential relaxation behavior show considerable promise for distinguishing structural differences that would not be apparent in the normal $_{13}C$ CP/MAS spectrum. 7 figures, 1 table.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 25375, 25376

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 26990

25382 **(LA—10044-MS) Aspen simulation of oil shale retort off-gas cleanup with venturi scrubbers.** Phillips, T.T. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011018.

A significant fraction of the product energy from oil shale retorting is contained in the retort off gas. Most oil shale processes use the retort off gas from plant fuel. The H_2S and NH_3 in retort off gas produce too much SO_2 and NOX to allow burning without a pollution control system. We used the ASPEN flowsheet simulator to model retort off-gas cleanup by venturi scrubbers. Venturi scrubbers are commonly used to remove particulates from gas streams, but the scrubbing liquid also absorbs some NH_3 and H_2S from the gas. The ASPEN venturi scrubber model makes good predictions of the particulate removal efficiency. The ASPEN estimates for H_2S and NH_3 absorption are higher than the equilibrium absorption predictions made by a state-of-the-art sour water vapor-liquid equilibrium model, TIDES. The discrepancy probably results from trying to simulate an electrolyte system with a vapor-liquid equilibrium model that is designed for molecular systems. The simulation indicates that a venturi scrubber may absorb enough NH_3 to serve as the primary NH_3 removal system. The H_2S absorption is quite low, however, and some other process is needed to remove the H_2S. 17 references, 6 figures, 3 tables.

25383 (LBL—13500, pp 4.40-4.45) **Development of low-cost grouts from spent oil shale.** Persoff, P. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25384 (LBL—13500, pp 4.45-4.50) **Analytical methods for quantitating performance of oil shale wastewater treatment.** Daughton, C.G.; Jones, B.M.; Sakaji, R.H.; Thomas, J.F. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25385 (LBL—13500, pp 4.51-4.57) **Microbial aspects of oil shale wastewater treatment.** Jones, B.M.; Sakaji, R.H.; thomas, J.F.; Daughton, C.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25386 (LBL—13500, pp 4.57-4.62) **Processes for the physico-chemical treatment of oil shale wastewaters.** Sakaji, R.H.; Jones, B.M.; Thomas, J.F.; Daughton, C.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 25354, 25359, 27060

25387 (LBL—13500, pp 4.37-4.40) **Mathematical model for leaching of organic carbon from in-situ retorted oil shale.** Hall, W.G.; Selleck, R.E.; Thomas, J.F. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

05 NUCLEAR FUELS

0502 Exploration

25388 **(DOE/GJ/01660—T1) Catahoula Formation of the Texas Coastal Plain: depositional systems, composition, structural development, ground-water flow history, and uranium distribution.** Galloway, W.E. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1977. Contract AC13-76GJ01660. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010477.

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The Catahoula Formation of the Texas Gulf Coastal Plain consists of two depositional systems-the Gueydan bedload fluvial system of the Rio Grande embayment and the Chita-Corrigan mixed load fluvial system of the Houston embayment. Both systems contain distinctive fluvial channel-fill, crevasse splay, floodplain, and lacustrine facies, which tend to persist vertically through the section. The paleoclimate varied from subarid in the Gueydan system to humid in northeastern parts of the Chita-Corrigan system. Gueydan sands are dominated by plagioclase feldspar and volcanic rock fragments reflecting a western source; in contrast, Chita-Corrigan sands are quartzose and were primarily reworked from mixed sedimentary terranes. Clay composition reflects alteration to montmorillonite and kaolinite of large volumes of volcanic ash deposited in both systems in response to pedogenesis and shallow burial diagenesis. Growth faults initiated by early Tertiary deltaic progradiation extend up into the Catahoula and profoundly influence trends of fluvial sand units and post-depositional ground-water flow. Consequently, fault zones may localize uranium mineralization, but faulting is not necessary for development of commercial deposits. Diagenetic features, distribution of trace uranium in fine-grained tuffaceous facies, and reconstructed ground-water flow history in the Catahoula provide the basis for interpretation of a terrigenous coastal plain uranium cycle. The inferred uranium cycle provides criteria that can be used to compare the uranium potential of the Gueydan and Chita-Corrigan fluvial systems and to determine the possible distribution and nature of mineralization within each depositional system. These criteria apply similarly to other potential coastal plain uranium host systems. 93 references, 31 figures, 2 tables.

25389 **(LA—9897-MS) Geochemical Atlas of Alaska.** Freeman, S.H.; Broxton, D.E.; Bolivar, S.L. (Los Alamos National Lab., NM (USA)). Oct 1983. Contract W-7405-ENG-36. 266p. (GJBX—32(83)). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84011004.

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The Geochemical Atlas of Alaska is a 1:6,000,000-scale (1 cm = 60 km) pictorial representation of regional, geochemical-survey data acquired by the Los Alamos National Laboratory as part of the Hydrogeochemical and Stream-Sediment Reconnaissance portion of the US Department of Energy's National Uranium Resource Evaluation program. Stream- and lake-sediment samples from 61,923 locations, distributed over most of Alaska, were collected and analyzed. Standardized field and analytical procedures were employed throughout. Universal kriging techniques were used to interpolate the data to a 5-km by 5-km grid (resulting in 46,276 grid cells), and the results are displayed as images with color and color intensity representing elemental concentrations. Single-element color plates display the concentrations in statistically chosen intervals as different colors and shades of colors. Three-element color plates display three elements simultaneously, each element being displayed in one of the primary colors (red, green, or blue) with 256 levels of color intensity representing the concentrations for each element. Text describing the sampling, chemical analysis, and data-processing procedures, accompanied by transparent overlays providing geographic index information, sample location and type, land control, and mineral occurrence information are also included to aid the reader with the interpretation of the geochemical data on the color plates. Examples of the correlations among the elements and (1) geology and (2) areas of potential mineralization are likely provided. 29 references, 4 figures, 2 tables, 49 plates.

25390 **Display techniques for integrated data sets.** Freeman, S.B.; Bolivar, S.L.; Weaver, T.A. (Los Alamos National Lab., NM). *Computers and Geosciences;* **9**: No. 1, 59-64(1983).

At Los Alamos National Laboratory, geoscientists have assembled and integrated 30 geological, geophysical, and geochemical data sets with four Landsat bands for the Montrose 1° X 2° quadrangle, Colorado. Three graphical displays were developed to determine if visual analysis of the data facilitated interpretation. Two displays project the data spatially: gray-level maps project values of a single data set, and three-color overlays project the values of three data sets simultaneously. The third display, a three-dimensional plot, graphs three data sets and allows examination of relationships in parameter space. Two examples illustrate the potential applications of the display techniques. Uranium in sediments, uranium in waters, and equivalent uranium each provide unique information about uranium distribution in the quadrangle. However, the combined data convey more information than each data set separately. Copper, lead, and zinc displays allow identification of all the base-metal districts and convey information about the geochemical character of the deposits. Visual displays greatly increase efficiency of analysis and interpretability of diverse geologic data sets.

0503 Mining

REFER ALSO TO CITATION(S) 25529, 25530, 25531

25391 **Numerical simulation of uranium in-situ mining.** Nguyen, V.V.; Pinder, G.F.; Gray, W.G.; Botha, J.F. (Princeton Univ., NJ). *Chemical Engineering Science;* **38**: No. 11, 1855-1862(1983). Contract AC03-80SF11489.

A concise mathematical description of the uranium alkaline leaching process, applicable to two major types of low-grade ores: uraninite and pitchblende, is presented. The resultant multispecies system of coupled reactive transport operators is subsequently solved using the collocation methods under isothermal conditions. The described one-dimensional simulator has been subjected to a wide range of numerical conditions which are constructed to represent currently simulated straight-tube porous medium experiments. Concentration profiles of all species pertinent to the reaction mechanism are plotted. The effects of leach solution quality, initial and transport conditions on the leached produce are examined. Also studied is the influence of the Boltzmann rate constant on the iteration scheme. Conclusions drawn from these quantitative results form a proper basis for both theoretical and future studies of the in-situ mining problem. Furthermore the analysis has offered new insight into the simultaneous interactions between the basic processes of convection, hydrodynamic dispersion, erosion or deposition, and reaction within a general multispecies system. 1 table, 3 figures.

0504 Feed Processing

25392 **Fluorination process using catalysts.** Hochel, R.C.; Saturday, K.A. (to Dept. of Energy). US Patent Application 6-526,249. 25 Aug 1983. 28p. Contract AC09-76SR00001.

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A process is given for converting an actinide compound selected from the group consisting of uranium oxides, plutonium oxides, uranium tetrafluorides, plutonium tetrafluorides and mixtures of said oxides and tetrafluorides, to the corresponding volatile actinide hexafluoride by fluorination with a stoichiometric excess of fluorine gas. The improvement involves conducting the fluorination

of the plutonium compounds in the presence of a fluoride catalyst selected from the group consisting of CoF_3, AgF_2 and NiF_2, whereby the fluorination is significantly enhanced. The improvement also involves conducting the fluorination of one of the uranium compounds in the presence of a fluoride catalyst selected from the group consisting of CoF_3 and AgF_2, whereby the fluorination is significantly enhanced.

25393 **Reductive stripping process for uranium recovery from organic extracts.** Hurst, F.J. Jr. (to Dept. of Energy). US Patent Application 6-504,904. 16 Jun 1983. 19p. Contract W-7405-ENG-26.

In the reductive stripping of uranium from an organic extractant in a uranium recovery process, the use of phosphoric acid having a molarity in the range of 8 to 10 increases the efficiency of the reductive stripping and allows the strip step to operate with lower aqueous to organic recycle ratios and shorter retention time in the mixer stages. Under these operating conditions, less solvent is required in the process, and smaller, less expensive process equipment can be utilized. The high strength H_3PO_4 is available from the evaporator stage of the process.

0505 Enrichment

REFER ALSO TO CITATION(S) 25554

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 25558, 25566, 25568, 26498

25394 **Thermodynamic measurement and modeling of (UC/sub 1-x O/sub x).** Besmann, T.M. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **66**: No. 5, 353-358(May 1983). Contract W-7405-ENG-26.

From 84. annual meeting, American Ceramic Society; Cincinnati, OH, USA (5 May 1982).

Measurements were made of (CO) pressure over (UC/sub 1-x/O/sub x/) at 1823, 1773, 1673, 1573, and 1473 K for various values of x, in the presence of ($UC_{1.86}$). The data were used to model (UC/sub 1-x/O/sub x/) as a solid solution of (UC) and (UO), where δG/sup xs/ is represented by an expansion in two terms, the first of which is temperature-dependent. The model allows for the accurate prediction of chemical activities and phase equilibria in regions also containing ($UC_{1.86}$), (UO/sub 2-y/), ($UC_{1.86}$)-(UO_2), and (UO/sub 2-y/)-(U).

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 25501, 25556, 25560, 25562, 25567, 25568, 26572

25395 **(DP—1671) Dissolution of uranium fuel tubes in nitric acid.** Chesna, J.C.; Gray, L.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Feb 1984. Contract AC09-76SR00001. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010928.

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The dissolving and crushing characteristics of uranium fuel tubes were studied to provide data required for nuclear safety evaluations. Dissolution of low-enriched fuel in the Savannah River Plant annular dissolver would be restricted if fragments formed that could escape from the annulus and form a more reactive lattice. Experimental studies showed that significant quantities of fragments will not be formed even in the event of accidentally double-batching the dissolver. Any fragments that are formed will be readily dissolved and a more reactive configuration is never formed.

25396 **(EUR—7671) Characterization of activities associated with irradiated fuel element claddings.** Jenkins, I.L.; Bolus, D.J.; Glover, K.M.; Haynes, J.W.; Mapper, D.; Marwick, A.D.; Waterman, M.J. (Commission of the European Communities, Luxembourg). 1982. 226p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE84700964.

The object of the present work was to characterise the natures and amounts of the various , β, and activities associated with cladding hulls. The claddings studied were stainless steel from a fast reactor and from an advanced gas reactor and zircaloy from a boiling water reactor, from a pressurized water reactor and from a steam generating heavy water reactor. The hulls were examined by the following methods: alpha spectrometry to identify and quantify the α emitters and to estimate their depths of penetration, partial and complete dissolution of hulls followed by gross α counting, α spectrometry and γ spectrometry, fission track autoradiography to determine the distribution of fissile material associated with hulls, neutron activation to determine the total fissile content of the hulls, chemical separations followed by β counting and chemical treatment with various reagents to examine the ease of decontamination.

25397 **(Juel-Spez—207) Reprocessing of nuclear fuels.** Baumgaertel, G.; Brueckner, C.; Stoeber, H.; Huppert, K.L.; Merz, E.; Paschke, M.; Pohlen, E.; Zimmer, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). May 1983. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751263.

The survey on hand aims at analysing in an unbiassed way the great number of recently issued inconsistent statements on pros and cons of prompt disposal of spent fuel from German nuclear power plants by reprocessing it according to the PUREX principle. Nuclear energy opponents emphatically doubt the technical feasability. Discussions on the issue were actually initiated by the official inquiry commission "future energy policies" of the 8th Bundestag of the FRG; in its final report on June 27, 1980 the commission also made suggestions concerning the erection of a demonstration reprocessing plant. On the authority of the Federal Minister of Research and Technology, Professor Wolf Haefele did a survey determining the ideal size of a demonstration reprocessing plant which the Federal Bundestag's Committee of Research and Technology approved in its meeting of December 7, 1981. When said survey was published, controversial discussion concerning contents and statements of the "Haefele-paper" began. Replies and independent statements were made, yet these have only in part been made available for the general public.

25398 **(LA—9911-C-Vol.1, pp 41-55) Potential fire or explosion risks in reprocessing plants.** Lefort, G. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Installations for reprocessing are large chemical plants handling large quantities of inflammable solvents and products allowing large risk of fire. Further, the chemical process involves the use of oxidizer and reducer agents which can have a very strong chemical activity and by certain circumstances create overpressures or large explosions. This paper shows the principal radioactive consequences to be retained in safety analyses. As an example the combustion phenomenon involved in a solid waste storage silo with irradiated uranium traces is described.

25399 **(Y/DK—354) Influence of uranyldibutyl phosphate on the uv/vis spectrophotometric online monitoring of uranium in tributylphosphate/hydrocarbon solvent.** Creech, E.T.; Rutenberg, A.C.; Smithwick, R.W. III; Seals, R.D. (Oak Ridge Y-12 Plant, TN (USA)). 30 Mar 1984. Contract AC05-84OS21400. 22p. (CONF-831025—32). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010725.

From 26. ORNL-DOE conference on analytical chemistry in energy technology; Knoxville, TN, USA (11 Oct 1983).

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Evidence has been presented based on chemical analysis, Infrared, NMR, and uv/vis spectroscopy to support a structure of $UO_2(DBP)_2$ for uranyl dibutyl phosphate complex. Further, that absorbance measurement based on uranyl tributyl phosphate standards can be in error when uranyl dibutyl phosphate is present. Also, due to the limited solubility of the $UO_2(DBP)_2$ at low pH, the complex can precipitate and contribute to emulsions.

25400 **Separation of uranium from technetium in recovery of spent nuclear fuel.** Pruett, D.J.; McTaggart, D.R. (to Dept. of Energy). US Patent Application 6-528,279. 31 Aug 1983. 9p. Contract AC05-84OR21400.

Uranium and technetium in the product stream of the Purex process for recovery of uranium in spent nuclear fuel are separated by (1) contacting the aqueous Purex product stream with hydrazine to reduce Tc^{+7} therein to a reduced species, and (2) contacting said aqueous stream with an organic phase containing tributyl phosphate and an organic diluent to extract uranium from said aqueous stream into said organic phase.

25401 **Integrated testing of equipment for FBR fuel reprocessing.** Burch, W.D. (Oak Ridge National Lab., TN (USA)). *Nuclear Engineering International;* **28**: No. 345, 37-39(Aug 1983).

To support the development in the United States of equipment and systems for a proposed demonstration reprocessing plant for fast reactor fuel, the Integrated Equipment Test facility has been built at Oak Ridge National Laboratory for trials of prototype hardware systems. The design and operation of the test facility are described.

25402 **(DP-tr—66) Dynamic model building and identifying on the countercurrent extraction process with microcomputer.** Wenbao, Dong; Hexin, Yan; Li, Guan. Translated from *Ta-lien Kung Huseh Yuan Huseh Pao ;* **22**: No. 1, vp(Mar 1983). Contract AC09-76SR00001. 18p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010373. DE84010373

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In this paper, dynamics of Purex Process 1A tank in the reprocessing of nuclear power reactor fuels is researched to find optimum operation and control conditions from the point of view of control engineering. By process analysis and system identification, direct dynamic model of countercurrent extraction process, describing the sensitive stage on the multistage, and its digital simulation program are presented. The model construction is simpler, the calculation and memory content are smaller than that cascade model. It is proper to microcomputer treatment and may reflect the process mechanism more closely. The minimum order of the model is determined by the number of the sensitive stage. The theoretical values in the digital simulation are coincident with the experiment values and meet the needs of the technology. Thus, the theory and method for analyzing dynamics and selecting the optimum operation and control conditions on the multistage countercurrent extraction process have been proposed.

25403 **Energy dispersive K x-ray fluorescence analysis for on-line process control of heavy metal concentrations.** Camp, D.C. (Lawrence Livermore National Laboratory, P.O. Box 808, L-233 Livermore, CA 94550). pp 1467-1472 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The analytical technique of energy dispersive x-ray flouresence analysis (XRFA) is studied in this paper. By using XRFA it is possible to measure nondestructively quantitative concentrations of heavy metals from process streams directly through industrial gauge pipes. The semiconductor detector, a high purity germanium detector (HPGe) housed in a sealed and evacuated cryostat is described. Two 5 to 10 millicurie radioactive Co-57 sources are used instead of an x-ray tube to stimulate x-ray emission. Analog electronics and analog to digital converter are also described. Some installations of XRFA at the Savannah River reprocessing plant and at the Allied General Nuclear Services plant are noted. Several reasons why the K x-ray flouresence analysis technique is innovative and practical for on-line or off-line near-real-time applications are summarized.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 25491, 25504, 25505, 25524, 25525, 25534, 25535, 25536, 25537, 25538, 25539, 25540, 25541, 25542, 25543, 25544, 25545, 25546, 25547, 25548, 25549, 25551, 25552, 25553, 25574, 25575, 25576, 25577, 25897, 26585, 26586, 26587, 26588, 26589, 26591, 26592, 26593, 26594, 26595, 26597, 26598, 26599, 26600, 26603, 26605, 26606, 26607, 26609, 26610, 26611, 26612, 26613, 26614, 26621, 26622, 26625, 26626, 26628, 26629, 26630, 26653, 26678

25404 **(BEC-MRS—3304) Monitored Retrievable Storage conceptual system study: open cycle vault.** Smith, R.I. (Boeing Engineering Co., Seattle, WA (USA)). Nov 1983. Contract AC06-76RL01830. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84008965.

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This report provides a modified description of the Open Cycle Vault Storage Concept which meets a specified set of requirements; an estimate of the costs of construction, operation, and decommissioning of the concepts; the costs required to expand the facility throughput and storage capability; and the life-cycle costs of the facility. 11 references, 23 figures, 35 tables.

25405 **(BMFT-FB-K—83-002) Characterization of spent fuel for disposal without reprocessing.** Wuertz, R.; Ellinger, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751259.

A characterization of irradiated LWR-fuel was performed as a basis for the radiological assesment of a repository for spent fuel elements. It is intented to exclusively contribute to the description of activity release from fuel elements under accidental conditions in the post-operational phase of a repository. Data were collected on the axial and radial distribution of activity in fuel rods, the macroscopic and microscopic fuel surface; porosity and the chemical state of fission nuclides in LWR-fuels.

25406 (CONF-830528—Vol.1, pp 29-38) **1982 Revision of the IAEA transport regulations.** Barker, R.F. (International Atomic Energy Agency, Vienna, Austria). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Some of the problems establishing uniform international transport safety standards are discussed; the status of the 1984 revision is reviewed; the major changes proposed for inclusion in that revision are identified; and some of the problems foreseen in its implementation are discussed. 17 references.

25407 (CONF-830528—Vol.1, pp 42-53) **IAEA regulations for the safe transport of radioactive materials: revised A_1 and A_2 values.** Goldfinch, E.P. (Central Electricity Generating Board, London, England); Macdonald, H.F. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The Q system described here represents a development and extension of the earlier A_1/A_2 system. It incorporates the latest recommendations of the ICRP and by explicitly identifying the dosimetric considerations underlying the derivation of Type A package limits provides a firmer and more defensible basis for the IAEA Transport Regulations. Overall the use of the Q system introduces only relatively minor variations in the A_1 and A_2 values compared with those in the current Regulations. Where major variations in the Type A package contents limits for beta emitters determined by Q/sub B/ and particularly Q/sub D/. Isolated relaxations in the contents limits occur due to changes in dosimetric data introduced in ICRP Publication 30, as in the case of ^{90}Sr, and more generally in the case of special form alpha emitters due to the revised definition of Q/sub F/. 18 references.

25408 (CONF-830528—Vol.1, pp 54-58) **Transport of RAM in tanks: how to fit into the IAEA safety philosophy.** Schulz-Forberg, B.; Ulrich, A. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The transport of radioactive materials (RAM) in tanks will become a field of increasing interest. Especially for substances with low radioactive hazard but may be with subsidary risks which can overrule the RAM-philosophy. The IAEA should pay attention to the problem whether to take over a more active part in the non-nuclear field of transport regulations by influencing and using the outcome of RAM transport conditions or to incorporate some or all provisions for tank transport in their own regulations. The necessity to solve the problems of shipments of substances with low radioactive hazards but high chemical hazards is highlighted by the requirements for UF_6-cylinders. Up to now UF_6 is listed in class 7 only, but the IAEA requirements for large UF_6 cylinders don't come up to the level of requirements needed for the toxic and corrosive nature of UF_6. 5 references.

25409 (CONF-830528—Vol.1, pp 59-66) **IAEA's role in achieving and assuring safety in the transport of radioactive materials.** White, M.C. (International Atomic Energy Agency, Vienna, Austria). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The results of the radiological impact studies, the data on shipments and the feedback from compliance assurance actions will help identify any shortcomings or weaknesses in the Regulations. The Advisory Material and the Explanatory Material, by amplifying the various requirements and elaborating the purpose and reason(s) for them, will help users understand the Regulations. These documents may also help motivate users. Quality Assurance will help prevent problems in the implementation process. Compliance Assurance will detect and lead to the rectification of failures in the implementation process. The data transfer on Certificates will aid in stopping the use of unsafe packages. 17 references.

25410 (CONF-830528—Vol.1, pp 75-79) **Licensing experience in obtaining approval of Type B packagings.** Vaughan, R.A. (Croft Associates Ltd., Oxon, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The following licensing problem areas are discussed: interpretation of the regulations; relevant experience; design standards; relevance to safety; data base; calculative methods; reasoned argument; testing requirements; modelling standards; and acceptance criteria.

25411 (CONF-830528—Vol.1, pp 80-88) **Safety assessment and fire test on Type B packages of combustible thermal insulator for radioactive materials.** Shimada, H.; Miyazaki, S.; Matsubara, Y. (Fire Research Inst., Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

From the test results about two Type-B packagings, it was found that the maximum temperatures sometimes appeared after more than three hours. These temperature rises may be caused by the combustion of thermal insulators. Inspite of these results, both Packaging 1 and 2 were proved to have enough ability to keep their integrity. It is desirable, however, to determine the fire safety according to the maximum temperatures of each internal containers. So, about packagings using combustible thermal insulators, we think it conservative and necessary to eliminate the provision which allows the artificial cooling after three hours. 2 references, 9 figures, 2 tables.

25412 (CONF-830528—Vol.1, pp 168-172) **World-wide risk assessment of the transportation of radioactive materials.** Ericsson, A.M.; Elert, M. (Kemakta Konsult, Stockholm, Sweden). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The aim of the project reported in this paper is to develop the means and methods for a risk analysis of the transportation of radioactive materials throughout the world. The project was initiated by the Standing Advisory Group on the Safe Transport of Radioactive Materials (SAGSTRAM) of the IAEA. In 1979 the Swedish Nuclear Power Inspectorate and the IAEA signed an agreement on the development of a model for calculation of the transport risk. Member States of the IAEA are invited to use the model for a risk assessment of the transportation of radioactive materials in their own country. These assessments will be collected and analyzed and a world-wide risk assessment performed. The IAEA has the overall responsibility for the project and administers it. Sweden manages the project and has performed the applied research with the assistance of research support groups which have supplied data and analyses and performed some other parts of the project. An Oversight Committee with participants from eight Member States has reviewed the progress and has given valuable recommendations. It was important that the model had the sophistication and flexibility required for its use by all Member States but still was easy to handle. The risk calculations are performed by the computer code INTERTRAN which is based on the American computer code RADTRAN II developed by Sandia National Laboratories, Albuquerque, NM. The methodology of the RADTRAN II as well as data and format of the input and output was changed to make the code more internationally oriented. 2 references.

25413 (CONF-830528—Vol.1, pp 184-191) **Evaluation of the radiological risk resulting from road transportation of tritiated water.** Menossi, C.A.; Segado, R.; Reyes, R. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A probability model for the evaluation of the individual radiological risk resulting from road transportation of tritiated water in 200-liter drums is presented. In order to evaluate such risk, an evaluation must be made of the probability for an individual to be involved in the consequences of a radiological transport accident, to incur a given dose and to suffer deleterious effects resulting from the dose incurred. With the purpose of quantifying the importance of accidents, a severity level classification was adopted as a function of the fraction of liquid volume spilled as a result of the accident. Considering the above-mentioned severity classification and the transported volume, the volume and the spill area are implied, while the soil characteristics are taken into account. By evaluating the spill characteristics, the average meteorological conditions in the area under analysis and the activity concentration of the transported liquid, the activity concentration values for tritium in air may be estimated, thus allowing calculation of the effective dose equivalent to be incurred by the individual who is most exposed to the consequences of an associated event. As a result of the summarized analysis above, a value of the individual risk per unit of activity concentration is obtained for tritium and for a given volume of transported liquid. 8 references.

25414 (CONF-830528—Vol.1, pp 200-204) **Acceptability criterion applicable to accidental cases in the transport of radioactive materials.** Biaggio, A.L. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

During the last few years, there has been a strong appeal for an agreed-upon, world-wide set of acceptability criteria to be used in the process of developing or reviewing regulations for the safe transport of radioactive materials. While the ICRP System of Dose Limitation could be taken as a set of acceptability criteria applica-

ble to routine transport, as well as to minor accidental cases, the low-probability high-consequence accidental cases require concepts and criteria which have not yet been developed in the ICRP recommendations or in other radiation protection documents. It is the intention of this paper to promote a discussion on a set of acceptability criteria applicable to regulations for the safe transport of radioactive materials. Assuming that acceptability criteria applicable to routine transport and to minor accidental cases are already available, low-probability high-consequence accidental cases are specifically addressed by proposing the use of a probabilistic criterion based on the experience gained in the field of safety regulations for nuclear power plants. The role of the individual risk as an acceptability criterion is described, and the significance of the collective impact of an accident as a safety decision tool is discussed, both by using an ideal case. The procedure and the information needed for evaluating individual risks in the transport of radioactive materials are also briefly described, and a level of individual risk, which in the author's opinion might be acceptable for regulatory purposes, is suggested. Finally, it is suggested that an acceptability criterion based on individual risk consideration could already be initiated for low-probability high-consequence accidental cases in the transport of radioactive materials. 13 references.

25415 (CONF-830528—Vol.1, pp 231-237) **Planning and experience on the dry storage of Diorit spent fuel.** Ospina, C. (EIR, Wuerenlingen, Switzerland); Baatz, H.; Methling, D. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The dry storage and transport cask was delivered at the end of December 1982 and the fuel loading facilities were tested at the reactor site. The loading of the DIORIT fuel was achieved in early May 1983, and the cask is operating normaly. A measurements campaign has started, and it is expected to deliver very useful information in respect to dry storage of spent fuel. The project has been valuable in assessing this new storage technology and the different problems encountered from its conception through its execution. Some special achievements include: this cask is the first commercial unit in service; the degree of difficulty of the work is reflected in the quality of these achievements, which simultaneously are the result of good collaboration between research and industry. 5 references, 3 figures, 2 tables.

25416 (CONF-830528—Vol.1, pp 238-239) **Super Phenix spent fuel storage cask, Castor SPX.** Lauer, H. (Centrale Nucleaire Europeene a Neutrons Rapides S.A., Lyon, France); Michoux, H.; Hueggenberg, H.; Janberg, K.; Rittscher, D.; Renavot, J.M. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Boundary conditions are given for the prototype cask called Castor SPX. Test results prove that storage of high-power/high burn-up fast breeder fuel elements in sodium-filled canisters within nodular cast iron casks is a feasible solution.

25417 (CONF-830528—Vol.1, pp 240-241) **Operating experience of cask-type dry storage and spent fuel performance.** Einfeld, K. (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen mbH, Hannover, Germany); Fleisch, J.; Luehrmann, A.; Ramcke, K. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The present status of the ongoing pilot size demonstration of cask storage involving 16 irradiated Zircaloy-clad BWR fuel assemblies from the Wuergassen power station in a Castor cask is discussed. The demonstration program is conducted at the reactor site, where the fuel was discharged and the cask loaded in the reactor pool after one year cooling time. 1 figure.

25418 (CONF-830528—Vol.1, pp 242-247) **TN 1300 transport/storage cask system.** Keese, H.; Anspach, W.; Christ, R. (Transnuklear GmbH, Hanau, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Qualification and application of the basic design of the TN 1300 transport/storage cask are discussed. 2 references, 4 figures.

25419 (CONF-830528—Vol.1, pp 248-250) **Storage and transportation of spent fuel and high-level waste using dry storage casks.** Eggers, P.E. (Ridihalgh, Eggers and Associates, Inc., Columbus, OH). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper describes the REA 2023 dry storage cask which has been designed for on-site storage and transportation of spent fuel and high-level waste. The REA 2023 is the first domestic commercial spent fuel dry storage cask completed for the Department of Energy program for demonstration of methods to improve on site utility fuel storage capacity. A description of the operations required for on-site handling and storage is provided with illustrations and photographs of the fabricated cask. An auxiliary skid is also described which is designed for both on-site handling/storage and transportation. A description of the lifting yoke and transportation impact limiters completes the total system for storage and transportation of spent fuel and high level waste in the REA 2023 casks.

25420 (CONF-830528—Vol.1, pp 300-308) **Test and analysis on impact characteristics evaluation of nuclear fuel packaging loaded on vehicle.** Uchino, Mamoru; Sakamoto, Masataka; Shimoda, Atsumu. (Mitsubishi Metal Corp., Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The characteristics of impact to transport containers were clarified by collision test and analysis in the case of small packagings, such as UO_2 powder transport containers, that are loaded in plural numbers and by theoretical analysis using a spring-mass model of particles model in the case of large packagings, such as the new fuel assembly, that can be handled singly and independently. Principal characteristics are as follows: (1) The crush impact acceleration of containers is about $1/10 \sim 1/3$ of 9-m free drop acceleration; (2) the crush impact loading of containers is observed to be smaller than 9-m free drop loading due to the secured buffer absorption. Therefore the crush impact deformation of containers is smaller than the 9-m free drop deformation. Finally, it has been proved that the UO_2 powder container is safe at 50 km/h collision in the way of transportation with buffer after confirming the safety of the container by the drop test prescribed in technical standards (regulations). 10 figures, 2 tables.

25421 (CONF-830528—Vol.1, pp 413-414) **Enhancing public acceptance of radioactive materials transport through improving and enlarging public understanding.** Shepherd, E.W. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The use of an integrated set of informational tools, based on an analysis of the questions and concerns of the public, is presented. This technique of interacting with the public has been successful in increasing public acceptance of radioactive materials transport.

25422 (CONF-830528—Vol.1, pp 490-492) **Facility - transportation system interface at COGEMA (experience in taking delivery of spent fuel).** Lenail, B. (COGEMA, Velizy-Vollacoublay, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

COGEMA has long experience in taking delivery of spent fuel from LWR's. This activity is now fully industrialized. Great care is taken by COGEMA and their affiliates in this business, generally beyond the normal regulatory limits, and this is quite normal,

COGEMA wanting to prevent, by all possible means, causes of incidents or accidents which could destroy the position it has established and the confidence placed in it by many customers. It is clear that the situation is quite different at reactors and at reprocessing plants; the limited number of flasks handled at reactors (in general five per year) is generally not enough to lead reactor operators to invest in sophisticated equipment and to adopt procedures allowing extremely small exposures of their personnel, while the great number of flasks received each year in a plant like La Hague (not fewer than 200 per year) justifies the investment in more specialized equipment (automation, remote operation, more sophisticated tools, etc.) and allows the personnel to be very well trained to that particular type of work. These are factors leading to very limited exposures of the personnel although the work performed in a repocessing plant is generally more complex (deeper decontamination, closer work, maintenance, etc.) than in a reactor.

25423 (CONF-830528—Vol.1, pp 493-499) **WIPP design flexibility for defense TRU waste transportation systems interface.** Johnson, J.E. (Westinghouse Electric Corp., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-78AL05346.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper identifies the Waste Isolation Pilot Plant (WIPP) interfacing systems that mate with transportation systems.

25424 (CONF-830528—Vol.1, pp 508-515) **Operational experience in loading spent fuel casks in European LWRs.** Herberholz, K. (NTL Nukleare Transportleistungen GmbH, Hanau, Germany); Aupetit, J. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Dry casks have developed from the 30-tonne cask, designed for low burn-up fuel, low pay loads of approximately 1 tonne of irradiated uranium with low decay heat, up to the modern day 110-tonne cask, which transports high burn-up fuel, higher and more economical pay loads up to 6 tonnes of irradiated uranium with a considerably higher decay heat. Similar developments have been made with the wet type cask, progressing from the 50-tonne to the 100-tonne cask. Developments and experience have resulted in the improvement of cask features, loading techniques, and the associated handling equipment. The following areas of advancement are described: use of protective skirts to avoid contamination; orifice operation; cavity drying; leak testing; and handling equipment. In addition, the management aspects of cask loadings are considered. 2 figures.

25425 (CONF-830528—Vol.1, pp 516-522) **Storage facility for casks awaiting shipment.** Sakai, Tadaaki; Nakajima, Takasuke. (Toyo Engineering Corp., Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The cask storage capacity is 26 casks. The maximum daily cask transport capacity is 12 casks between the ship and the facility and 6 casks between the power plant and the facility. The cask inspection is a periodic, self-initiated inspection which includes a visual inspection, an air leakage test, pressure test, etc. The pretransport test includes a surface temperature test, a leakage test, a surface contamination level test, etc. 7 figures.

25426 (CONF-830528—Vol.1, pp 525-531) **Current status of research and development for safe transport of nuclear materials in Japan.** Aoki, S. (Tokyo Inst. of Technology, Japan); Shimamura, S.; Fukuda, S.; Kawasaki, M.; Miura, M. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The safety research concerning nuclear fuel transportation is being executed in a wide range in Japan. These results are effectively used: to improve safety guidelines and to collect and analyze technical data for the evaluation of the safety; and to improve the safety measures of current transport system and its components. It will be necessary, from now onward, to systematize this research, to allot the research of the private sectors, and to promote rational and efficient execution of research is also extremely important. We are prepared to cooperate with countries and international organizations for the objective of furthering the safety of international transportation, and exchanging research results for higher efficiency. 4 references.

25427 (CONF-830528—Vol.1, pp 532-536) **IAEA coordinated research programme on safe transport of radioactive materials.** Bernardo, B.C. (International Atomic Energy Agency, Vienna, Austria). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A brief description of the research contracts and agreements is presented.

25428 (CONF-830528—Vol.1, pp 537-542) **Overview of DOE/PNC joint program on transportation technology.** Kikuchi, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan); Kubo, M.; Jefferson, R.M.; Allen, G.C.; Yoshimura, H.R.; Carlson, K.A. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This project is planned as a 4-year cooperative effort on transportation technology between the Department of Energy and the Power Reactor and Nuclear Fuel Development Corporation. In Japan, almost all overland transportation of nuclear materials except spent fuel is performed by truck. Activities in this project are to conduct risk assessments, to develop structural models, to conduct impact and fire tests, and to complete leakage tests for special nuclear materials (SNM:mixed-oxide fuel, plutonium powder, etc.) in simulated overland transportation systems under normal and accident conditions. The special nuclear material will be used as the fresh fuel for the fast breeder reactors. 8 references.

25429 (CONF-830528—Vol.1, pp 555-562) **Transport and storage of RAM: the role of BAM.** Schulz-Forberg, B. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

For the transport and storage of RAM the BAM is acting as: competent authority for the approval of special form materials; federal authority for the testing and evaluation of RAM packagings; and expert institute for the preparation of expertises for the storage of RAM. 4 references, 4 figures, 1 table.

25430 (CONF-830528—Vol.1, pp 563-570) **Proposed UK legislation to provide radiological protection for workers, with emphasis on its application to the transport of radioactive materials.** Holyoak, B. (Health and Safety Executive, London, England); Shaw, K.B. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In terms of the standards for packaging and labelling the proposed Regulations are consistent with IAEA SS No. 6 and continue the existing UK statutory requirements; they will provide statutory controls for those modes of transport presently subject to non-statutory conventions and by-laws. There are new requirements in the administrative arrangements for the provision of radiological protection. These requirements reflect the procedures presently used by responsible organizations and are compatible with IAEA SS No. 9(10). Thus our proposals will be compatible with the various International Transport Conventions when these are brought into line with IAEA SS No. 6 (1984). The proposals should secure a system of working which is sufficiently flexible that it will not impede legitimate carriage but will ensure that everyone involved,

either directly or indirectly, is provided with a satisfactory and uniform standard of radiological protection. As a consequence of the extensive consulation during the preparation of the proposals it is anticipated that the transport industry will be well disposed towards compliance; however should there be deviations from accepted standards enforcement action can be applied. 10 references.

25431 (CONF-830528—Vol.1, pp 571-578) **Planning of railway transport of radioactive materials as a consequence of public concern: the role of Competent Authority.** Orsini, A.; De Marco, I.; Faloci, C. (ENEA/DISP, Rome, Italy). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The actions undertaken by the Competent Authority and the measurements taken as a consequence by the National Railway Agency result in a better understanding from the public and a better acceptance from the workers. The improvements have been obtained without substantial increase in the cost of the transport of RAM. It demonstrates also that interventions of the Competent Authority are useful and contribute to a reduction of the public concern by an improvement in the information available to the public and to the workers, with the final result that further improvements for the nuclear safety and health protection in the transport of RAM have been provided. 3 tables.

25432 (CONF-830528—Vol.1, pp 583-592) **Analyses of notification, routing, and packaging for shipments of nuclear materials.** Pellettieri, M.W.; Welles, B.W. (International Energy Associates, Ltd., Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Although the ground work has been laid for the development of national standards and conformance to international standards for radioactive materials transportation; confusion, conflicts, and legal challenges have prevented implementation of a comprehensive system. Implementation of the NRC prenotification rule had produced the following perceived advantages or disadvantages: (1) the notices do not provide a planning data base for state emergency preparedness; (2) some states believed that the data was useful in defining the magnitude of potential hazards from radioactive material transport, and the notices enabled them to be more immediately responsive if necessary; (3) the NRC regional offices view the data use to be primarily as a historical record; (4) the shippers/carriers view the notices as another layer of regulated paperwork - the cost of which is passed on to the nuclear industry; and (5) concern exists regarding the safeguards provisions of Part 73 on the spentfuel shipments and the implementation by the states of this requirement. The DOT response to the NRC prenotification ruling has been: (1) the NRC rules are not preemptive of state or local prenotification requirements; (2) no national system for notification has been established; and (3) the post-notification requirements of DOT provide a more significant data base for state emergency planning. In order to implement the preemptive powers defined by the Appendix of HM-164, the DOT must rule state or local ordinances as inconsistent with federal policy; the inconsistency ruling may then be subjected to judicial review. Thus is a pattern developing of establishment of national policy by way of inconsistency rulings.

25433 (CONF-830528—Vol.1, pp 595-599) **Overview of the US government's radioactive material (RAM) shipping program: the DOE perspective.** Garrison, R.F. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This presentation provides an overview of the Department of Energy's activities in radioactive material shipments and highlights the Department's concerns, successes, and expectations for the future.

25434 (CONF-830528—Vol.1, pp 600-603) **Traffic manager.** Blalock, L.G. (Dept. of Energy, Oak Ridge, TN). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The requirements of today's DOE/contractor traffic management position and what dictates the need for this position are discussed.

25435 (CONF-830528—Vol.1, pp 608-612) **Cooperative government/nuclear industry intervention in achieving motor carrier rules uniformity for transporting radioactive material.** White, J. (J. White and Associates, Inc., Spokane, WA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The real key to motor common carrier regulation in the US is collective ratemaking. This issue is discussed.

25436 (CONF-830528—Vol.1, pp 613-620) **Controls necessary to assure regulatory compliance on radioactive material shipments.** Taylor, J.C. (Union Carbide Corp., Paducah, KY). Dec 1983. NTIS, PC A99/MF A01. Contract W-7405-ENG-26.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper describes the controls Union Carbide Corporation has established and the actions performed by their personnel to assure total regulatory compliance. These controls include the selection of reputable carriers providing quality transport vehicles combined with consistent comprehensive inspections performed on both the transport vehicle and the radioactive material shipment.

25437 (CONF-830528—Vol.1, pp 621-627) **Meeting the challenge of the future in international transport operations: a transporter's point of view.** Timm, U.E. (Transnuklear GmbH, Hanau, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The author gives some personal comments on the actual situation and possible trends in the international nuclear transport market and some views on possible consequences for the transport companies.

25438 (CONF-830528—Vol.1, pp 786-791) **US accident/incident experience in the transportation of nuclear fuel cycle material (1971-1982).** Emerson, E.L. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper provides an overview of the accidents and incidents that have occurred in the transportation of nuclear fuel cycle materials in the United States from 1971 through mid-1982. It is based upon information in the Radioactive Material Transportation Accident/Incident Data Base developed by the Transportation Technology Center (TTC) at Sandia National Laboratories. The data incorporates information from the Hazardous Materials Incident Report System (HMIR) of the US Department of Transportation (DOT) and from the files of the US Nuclear Regulatory Commission (NRC). 4 tables.

25439 (CONF-830528—Vol.1, pp 815) **Shipping papers: cornerstone of radioactive material transportation.** Yarborough, R.D. (Union Carbide Corp., Oak Ridge, TN); Schermerhorn, J.R.; Henry, B.E.; Reed, H.C. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

25440 (CONF-830528—Vol.1, pp 816-821) **Combined storage system for LWR spent fuel and high-level waste.** Baxter, B.J.; Ganley, J.T.; Washington, J.A. (GA Technologies Inc., San Diego, CA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The MODREX storage system consists of four basic elements: (1) the storage canister, (2) the storage module, (3) the storage cask, and (4) the transport cask. The storage canister is the heart of the system and, when used in combination with the module or either of the casks, allows the MODREX system to respond quickly to varied storage system requirements. The MODREX system can be used to hold either spent fuel assemblies or canistered solidified HLW. The ability to combine a basic storage canister with either a concrete module or a metal cask provides flexibility to meet a wide range of storage requirements. The spent fuel is stored in a dry, inert atmosphere, which essentially eliminates corrosion or deterioration of the cladding during extended storage periods. The storage canister and concrete storage module provide additional barriers against radioactivity release, enhancing long-term safety. Heat dissipation is passive, eliminating the need for additional emergency cooling systems or special redundancy. Modular, expandable construction permits minimum initial investment and capital carrying charges; additional capacity is built and paid for only as it is needed, retaining flexibility. 6 references, 2 figures, 1 table.

25441 (CONF-830528—Vol.1, pp 67-74) **Carriage of radioactive materials in Europe in consideration of the provisions concerning traffic, including the possibilities of a transformation of the 1984 edition of the IAEA regulations.** Ridder, K. (Ministry of Transport, Bonn, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In 1979, work on the new version of the IAEA Regulations Safety Series No. 6 began. The work will be approved by the Board of Governors in 1984. The new version of the IAEA Regulations will be published at the end of 1984. The international transport organizations will then begin to include these regulations into their own provisions. On account of the different procedures the ICAO in Montreal, the IMO in London, and perhaps also the Central Commission for Navigation on the Rhine in Strassburg will be able to adopt the new provisions in 1986, perhaps 1987. In European road and rail traffic this will not be the case before the end of 1987.

25442 (CONF-830528—Vol.2, pp 941-942) **Operating experience with two transport storage casks for surface storage of spent HTGR fuel elements.** Brinkmann, H.U. (KFA, Juelich, Germany); Duwe, R.; Engelstaedter, R.; Fleisch, J.; Luehrmann, A. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

For interim storage of spent fuel from German High-Temperature Pebble Bed Reactors a storage technique based on the cask concept was developed. The cask was designed with reference to the nodular cast iron cask developed for spent LWR fuel. Its safe operation has already been demonstrated. With respect to less stringent operating conditions of such casks for German HTGR spent fuel, the cask design was simplified without loosing any safety margins. The cask and its contents serve as a multibarrier containment according to the fact that the fuel elements (pebbles) are contained in canisters and the cask lid is provided with a metallic gasket in order to fulfill long-term storage aspects. The cask design meets all Type B (U) requirements according to the IAEA Regulations.

25443 (CONF-830528—Vol.2, pp 958-966) **Review of selected nuclear transport event case histories.** Grella, A.W. (US Nuclear Regulatory Commission, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper is a brief review of information on ten selected case histories of events on which the author has obtained information over the past 15 years. Recognizing that many of these events have previously been reported on individually, this paper is intended as a summary compilation for ready-reference use to any persons interested in studying this subject in further detail. Photographs of each of the accident/incident scenes, vehicles, or packages involved are included.

25444 (CONF-830528—Vol.2, pp 969-973) **Need to increase public awareness of the safety of radioactive materials transport.** Bishop, R.W. (Northeast Utilities, Hartford, CT). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

There are two aspects to the problem of the public perception of radioactive materials transport: the first is a lack of knowledge on the part of the public about the facts, and the second is the distorted presentation by the media. These two problems are obviously interrelated - the more unaware the public is of the actual safety of radioactive materials transport, the more it is likely to be influenced, and frightened, by inaccurate reporting. The obvious question is, what can we as an industry do to educate the public and to facilitate more neutral reporting about the facts involving radioactive materials transport? This question is answered by describing an excellent example of a situation where the industry acted cohesively and effectively to respond to fallacious allegations concerning the safety of the transportation of radioactive materials.

25445 (CONF-830528—Vol.2, pp 974-980) **Recent developments in the area of insurance and indemnity coverage for transportation of radioactive materials in the United States.** Brown, O.F. II. (Schwartzstein and Brown, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Recent developments in the area of insurance and indemnity coverage for transportation of radioactive materials in the United States are discussed. The description of the omnibus Price-Anderson insurance-indemnity system is updated. The present ten-year extension of the Price-Anderson Act expires in 1987. A comprehensive report to Congress from the NRC on whether to extend it is due by August 1, 1983. Before too many suggestions are made about some new form of coverage for transportation, careful consideration should be given to allowing the Act to continue to be applied to such activities in substantially its existing form. The Price-Anderson system is the most comprehensive federal program for compensating persons or organizations when damaged by an incident involving a hazardous material. While there always is room for improvement, the nuclear insurance-indemnity system, together with the stringent nuclear safety regulations, provides a very high level of public protection against the potential hazards of radioactive shipments. As I said in Berlin in 1980 and reiterate now, these standards should serve as examples to be emulated by anyone concerned with regulating any hazardous materials. 10 references.

25446 (CONF-830528—Vol.2, pp 988-994) **Importance of reportable events with regard to public acceptance.** Wehner, G. (Federal Ministry of the Interior, Bonn, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Although risk assessments have shown that the transport of radioactive material (RAM) only contributes a very small part of the overall risk of nuclear energy, the public is still concerned about the safety of these transport operations. This is due to the

fact that during such an operation RAM may come in the vicinity of everybody and that most people are familiar with the effects of ordinary transport accidents. It is therefore important to achieve public acceptance, that means, to convince the public that transport of RAM is really safe. Four points are of special importance in this connection: (1) information of the public about the safety philosophy and the radiation protection principles developed by the International Atomic Energy Agency (IAEA) for the transport of RAM. The planned edition of explanatory material to the IAEA Safety Series No. 6 - the so-called why document - is very important for this point; (2) information about the average and maximal individual annual doses for members of the public from normal transport of RAM; (3) information of the public about accident experiences in transport of RAM and the excellent safety standard reached in this field; and (4) information of the public about the extent and the results of governmental controls in this field. In the Federal Republic of Germany the states are requested to report to the Federal Ministry of the Interior all special events occurring during handling and carriage of RAM. The main purpose of these reports is to inform the competent authorities and to draw - if necessary - the conclusion for the improvement of protective measures.

25447 (CONF-830528—Vol.2, pp 995-997) **Low-level waste transportation: legislative issues in the Northeast United States.** Wight, A. (New Hampshire State Task Force on Low-Level Radioactive Waste Management, Concord); Goldsmith, M.; Murphy, J. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The development of the Northeast Interstate Compact is discussed.

25448 (CONF-830528—Vol.2, pp 998-1004) **Analysis of NEPA/CEQ requirements with respect to nuclear materials transportation.** Ross, K.E.L.; Welles, B.W.; Pellettieri, M.W. (International Energy Associates Ltd., Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper examines the responsibility of federal agencies concerned with nuclear materials transportation decisions that come within the scope of the National Environmental Policy Act of 1969 (NEPA) and the requirements established by the Council on Environmental Quality (CEQ). Two of the case histories presented in this paper focus on actions taken by the Nuclear Regulatory Commission (NRC) and the Department of Transportation (DOT). A third case history, in which the limits of environmental impact are judicially redefined, presents an analysis of NEPA application in an NRC licensing action. The decision by the US Supreme Court (April 19, 1983) disallowed psychological stress as a factor to be required in environmental analysis of federal actions. The review by the Supreme Court of environmental impact considerations required under NEPA is clearly transferable to federal actions involving transportation of nuclear materials. Of interest in these examples is the application of NEPA requirements for worst-case analysis and the employment of the rule of reason by a federal agency to determine the limits of its NEPA obligations.

25449 (CONF-830528—Vol.2, pp 1005-1011) **Significant recent developments in the United States courts affecting nuclear materials transportation.** DiStefano, J. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The most significant developments in the United States Courts affecting nuclear energy and the movement of nuclear materials stem from lawsuits in four states: New York, Washington, Illinois and California. While these complex cases touched on diverse issues affecting nuclear energy, this paper highlights only those features of most interest to this Symposium.

25450 (CONF-830528—Vol.2, pp 1012-1014) **Beyond the Association of American Railroads and Department of Energy workshop in 1981.** Carlson, K.A. (Dept. of Energy, Albuquerque, NM); Hardin, E.C. Jr.; Garrison, R.F. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

As part of an initial exchange of concerns between the railroad, Government, and nuclear transportation industry, a joint workshop was sponsored by the Association of American Railroads and the US Department of Energy in May 1981, in Columbus, Ohio, to identify issues in rail transport of nuclear materials and to provide a forum for discussion among shippers, carriers, and Government agencies. The issues were categorized into several specific areas: risk assessment and control, emergency response, public perceptions, packaging design, railcar design, regulations, routing, and prenotification. A number of recommendations resulted from the workshop discussions. Continuation of the DOE/AAR Planning Committee was suggested, as was the development of a joint industry and Government task force that would address issues pertaining to the measurement and control of risk. The AAR has been included as a participant in the package and railcar design peer review process. Government agencies, industry, and carriers should sponsor a workshop to clarify emergency response authorities, procedures, and liability for cleanup costs. Development of a uniform set of regulations at all jurisdictional levels would aid in the movement of radioactive materials.

25451 (CONF-830528—Vol.2, pp 1079-1086) **Thermal analysis of packaging using the integral method.** Lake, W.H. (US Nuclear Regulatory Commission, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Packaging designed to ship radioactive materials (RAM) in certain quantities must be subjected to conditions representing a fire test. This paper presents an analytic approach which may be used to evaluate many types of packages under fire test conditions. The paper considers packagings having thermal protection systems with high thermal resistance and low thermal diffusivity, such as wooden overpacks, insulated drums, etc.

25452 (CONF-830528—Vol.2, pp 1087-1094) **Heat transfer in a dry, horizontal LWR spent fuel assembly.** Fry, C.J. (Atomic Energy Establishment, Winfrith, England); Livesey, E.; Spiller, G.T.; MacGregor, B.R. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A series of experiments has been conducted to measure the steady-state temperature distribution through a dry 16 x 16 dummy PWR assembly lying horizontally in a close-fitting box. The experimental results have been analysed to obtain the pin cladding temperature distribution across the centre of the assembly. These measured temperatures have been compared against calculations with the computer code RIGG and good agreement has been obtained over a wide range of assembly powers and temperatures and with different filling gases. The experiments showed that natural convection inside the air-filled assembly had a significant effect upon the temperature profile. The temperatures in the lower half of the assembly were reduced and those in the upper half increased. These effects were reproduced in a simple RIGG model demonstration that these convection currents reduce the peak pin temperature slightly. The helium-filled assembly experienced no significant effects due to convection. The agreement between measured and calculated peak pin temperatures was, in general, very good, especially when the effects of convection were modelled. If a reduction of about 5°C due to convection is assumed for the tests in which the assembly was air filled, then the agreement over all the tests between the measured and calculated peak pin temperatures was +- 7°C. A significant part of this error is attributed to random errors in experimental power measurement and measurement of material properties.

25453 (CONF-830528—Vol.2, pp 1113-1120) **Thermal testing in support of the TRUPACT development program.** Diggs, J.M.; Yoshimura, H.R.; Uncapher, W.L. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Thermal testing has been performed as part of development activities in support of the design of the TRUPACT (TRansUranic PACkage Transporter). The TRUPACT contains polyurethane foam in the walls and door to provide both impact and thermal protection. The environmental tests series to assess thermal protection have included radiant heating tests, small unit fire tests, and full scale fire tests on foam bearing subsystems. To gather information on foam performance in both severe and near-regulatory environments, the polyurethane foams were tested in various configurations under fire simulation conditions. In parallel test programs, the foam underwent exposure to a radiant environment, (simulating the heat input to the foam from a fire) and exposure to an enclosed engulfing fire. The fire in this facility allowed for nearly uniform heat input in addition to approximating the chemical environment for the exposure of the unit. The test series described led to the qualification of various foams for use in the TRUPACT on the basis of thermal performance, the benchmarking of the thermal code used to evaluate changes to the TRUPACT design, and confirmation of the basic design philosophy. From these tests it was determined that the candidate foams perform best in an anaerobic environment. For this reason, a design criterion for the puncture system was set that it shall protect the foam closest to the containment cavity from air ingress. The concern of foam exposure to air due to a puncture on the TRUPACT ends has been addressed through additional testing and analysis not discussed here.

25454 (CONF-830528—Vol.2, pp 1156-1163) **Proposal of guidelines for selecting optimum options in packagings and transportation systems of spent fuel.** Saegusa, T.; Abe, H.; Fukuda, S. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Type and size of spent fuel shipping packagings and packaging transport ships in spent fuel transport system would have been determined separately in response to technical requirements etc. of reactor sites and reprocessing plants. However, since more and more spent fuel will be generated from world's nuclear power plants and will be transported much frequently to reprocessing plants or storage facilities, the current spent fuel transport system will have to be necessarily reexamined from the operational and economical aspects or an optimum transport system may have to be newly determined in the near future. In the literature, a variety of options are found, particularly of spent fuel packagings. This paper listed and classified options of spent fuel packagings and packaging transport ships in the transportation systems of spent fuel on the basis of literature surveys. These options were discussed from viewpoints of designers and users and compared in terms of transport efficiency. Finally, one way to determine an optimum transport system of spent fuel was indicated considering the total transport system in the light of safety, operational efficiency and economy.

25455 (CONF-830528—Vol.2, pp 1170-1176) **RAMPAC: a database of certified packagings for radioactive materials.** Haaker, C.K. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The Radioactive Materials Packaging database RAMPAC was created with a database management systems (System 2000) that requires little or no computer expertise. A few of the most basic features of System 2000 are described.

25456 (CONF-830528—Vol.2, pp 1183-1188) **Radioactive materials transportation: state regulation and enforcement.** Kinley, H.J. (Resource Communities Inc., Santa Fe, NM). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

All of the factors examined during this research - public concern, accidents, regulations, enforcement activity and enforcement resources - contribute to the overall effectiveness of a state program to ensure safe radioactive materials transportation. Of these, enforcement seems to be the most important, followed in importance by stringent regulations. Public concern seems to contribute equally to enforcement and stringent regulations, while accidents are the least important of all. Public concern about radioactive materials transportation is not generally a response to highway accidents; in fact, this association is evident in only a few states. The public seems to be more concerned about nuclear power and the disposal of radioactive and other hazardous wastes than about radioactive materials transportation. The impetus to adopt new regulations or to strengthen enforcement capability seems to come as much from concern about these related issues as it does from concern about the risks of nuclear materials transportation per se. The states with the most effective programs tend to be the ones that face the greatest risk: disposal site states, states along the corridors to disposal sites, or states with a relatively large number of nuclear reactors. In general, these states have adopted regulations that are more stringent than the USDOT Hazardous Materials Regulations and have developed an effective capability for enforcing them. A few states, such as North Carolina, have very effective programs based on federal regulations. The most effective enforcement programs combine the arrest powers of a state law enforcement agency, the expertise of a radiation control agency, and good coordination among all of the state agencies with jurisdiction in this area. When these three elements are present, and state patrols are trained in the regulations and know when to seek assistance, the enforcement programs work very effectively.

25457 (CONF-830528—Vol.2, pp 1189-1196) **Integrated metal container as a part of an integrated system for back end of irradiated fuel management.** Teper, B.; Reynolds, B.R. (Ontario Hydro, Toronto). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

An integrated container system for the transportation, extended storage and permanent disposal of either irradiated fuel bundles or reprocessing wastes is proposed which offers a more rational approach to the irradiated fuel management system. The integrated system is comparable in cost to other disposal-only systems although it has a more general range of applications covering all areas of irradiated fuel management.

25458 (CONF-830528—Vol.2, pp 1197-1200) **Implementation of HM-164: a historical perspective.** Taynton, L.F. (Science Applications, Inc., Oak Ridge, TN); Blalock, L.G. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

When Congress proposes and submits legislation to be enacted into law, discussion and debate accompany the proposal. Problems sometimes develop when legislation is implemented because the operational realities of that legislation may not have been considered fully during those discussions and debates. Such an implementation problem was encountered in early 1982 when Department of Transportation (DOT) Docket No. HM-164 became effective. The purpose of this presentation is to summarize the operational problems that were encountered during implementation and the cooperative effort that was initiated to overcome these difficulties.

25459 (CONF-830528—Vol.2, pp 1219-1225) **Design and testing of scale model transport systems.** Joseph, B.J. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Scale model testing has been used for many purposes over the years in such fields as aerodynamics, fluids dynamics, and engineering mechanics. There are basic engineering relationships involving momentum, stress-strain, velocity, density, energy, and force which can be evaluated through experimental methods using scale models. While scale model testing often complements analytical and full scale modeling activities, it may prove to be the most economical method for evaluating some complex systems. The Transportation Technology Center at Sandia National Laboratories (SNL) has conducted full scale and model tests on various transportation systems. The experiences from the various model testing programs have shown that the design, fabrication, assembly, instrumentation, documentation and testing steps contain complexities which might not be initially obvious. The purpose of this paper is to present practical information on the difficulties encountered in scale model testing of nuclear material transportation systems and to suggest methods to overcome modeling problems.

25460 (CONF-830528—Vol.2, pp 1243-1257) **Planning a transportation system for US defense transuranic waste.** Gilbert, K.V. (Rockwell International, Golden, CO); Hurley, J.D.; Smith, L.J.; McFadden, M.H.; Raudenbush, M.H.; Fedie, M.L. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The development and planning of a transportation system for US Department of Energy (USDOE) Defense Transuranic (TRU) waste has required the talents and expertise of many people. Coordination activities, design activities, fabrication, research and development, operations, and transportation are but a few of the areas around which this system is built. Due to the large number of organizations, regulations and personalities the planning task becomes extremely complex. The intent of this paper is to discuss the steps taken in planning this system, to identify the various organizations around which this system is designed, and to discuss program progress to date, scheduling, and future plans.

25461 (CONF-830528—Vol.2, pp 1373-1382) **Notes on the design of ships used in international transport of irradiated nuclear fuel.** Spink, H.E. (British Nuclear Fuels Ltd., Warrington, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In the discussion on design of ships for international transport of spent fuels, safety features and cargo are covered.

25462 (CONF-830528—Vol.2, pp 1383-1390) **Realization of a sea transport system for radioactive material.** Gustafsson, B. (Swedish Nuclear Fuel Supply Co., Stockholm); Lenail, B. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Design, manufacture, cold trials, and active operation of the sea transport systems are described.

25463 (CONF-830528—Vol.2, pp 1427-1432) **Criticality aspects of the transport of fissile materials.** Schweer, H.H. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The transport regulations require that no criticality occurs during the transport of fissile material, even under accident conditions. These conditions are well defined in the regulations, but no special advice is given to an applicant in which way he can comply with the regulations, for example, by stipulating an experimental or calculational procedure. A method applied at the PTB which may be useful for a person who applies for the approval of a fissile package by any competent authority is described.

25464 (CONF-830528—Vol.2, pp 1433-1439) **Criticality control of packagings designed for nuclear spent fuel.** Cagnon, R.; Morin, P.; Labrousse, M. (Transnucleaire S.A., Paris, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The IAEA Regulations for the Safe Transport of Radioactive Materials require that transport packagings shall be safe from criticality in any foreseeable circumstances during the life time and that spent LWR fuel assemblies shall be regarded as unirradiated. Additionally, the effeciency of built-in neutron absorbers shall be checked before first use and at maintenance periods. Methods proposed for those controls are described and discussed.

25465 (CONF-830528—Vol.2, pp 1486-1489) **20 years experience of large-scale movement of irradiated fuel by the CEGB.** Mummery, G.B. (Central Electricity Generating Board (HQ), London, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The Central Electricity Generating Board (CEGB) is responsible for the bulk generation and distribution of electricity in England and Wales. It has 8 operational power stations of the Magnox type and 1 operational station of the Advanced Gas Cooled Reactor (AGR) type, and 3 AGR stations where generation is expected to start during the current year. The operational stations generate 4500 MW(e). New fuel is supplied by British Nuclear Fuels Ltd. and after use in CEGB reactors the fuel is stored on site for a suitable cooling period for despatch to BNFL's storage and reprocessing facilities at Sellafield (formerly called Windscale). The CEGB is responsible for making the arrangements for the transport of its irradiated fuel to Sellafield. The first movements were made in 1962 and a total of more than 7000 movements have been made in the 20 year period. It is probably the largest-scale operation of this kind undertaken by any utility in the world. The arrangements for this traffic are described in this paper together with the emergency plan and the exercising of emergency arrangements.

25466 (CONF-830528—Vol.2, pp 1490-1494) **Transport of irradiated fuel to the La Hague reprocessing plant.** Lenail, B. (COGEMA, Velizy Villacoublay, France); Curtis, H.W. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The following topics are discussed: natural uranium fuel transport; LWR fuel transport; fast reactor fuel transport; methods of transport to La Hague; and flask handling at La Hague.

25467 (CONF-830528—Vol.2, pp 1513-1518) **MTR irradiated fuel transports.** Mangusi, J. (Transnuclear, Inc., White Plains, NY); Hannett, B.; Staake, T. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The transport of irradiated test reactor and research reactor fuel from overseas reactors to the US DOE facilities at Savannah River and Idaho is discussed. The transport of this fuel is subject to the same regulations as domestic power reactor fuel but is completed by the import/export aspects.

25468 (CONF-830528—Vol.2, pp 1535-1539) **Construction and inservice inspection rules for nuclear spent fuel and high-level waste transport packagings.** Goldmann, K. (Transnuclear, Inc., White Plains, NY); Brinkman, W.H.; Canonico, D.A.; Claverie, R.J.; Nickell, R.E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Rules for the construction and in-service requirements of containment systems of nuclear spent fuel and high-level waste transport packagings are being developed by the NUPACK Committee. The rules for construction will be incorporated into the ASME Boiler and Pressure Vessel Code as a new Subsection of Section III, Division I. Corresponding rules for inservice requirements will probably be established as a new Division in Section XI. The rules are being drafted by Task Groups on General Requirements; Design; Materials; Fabrication, Examination and Testing, and Inservice Requirements. The Task Groups are utilizing the format and to a great extent the existing text for other Section III components, as appropriate, in establishing the NUPACK rules. Outstanding issues which have not yet been resolved include some differences between NRC Regulatory Guide 7.6 and the ASME Code, protection criteria against brittle failure of ferritic materials and requirements for hydrostatic and leakage rate testing. The schedule for completing the first drafts of rules for construction and inservice requirements is June and November 1983, respectively. December 1984 is a target date for publication.

25469 (CONF-830528—Vol.2, pp 1540-1547) **Stowing of packages containing radioactive materials on conveyances in normal and accidental conditions.** Draulans, J. (TRANSNUBEL, Dessel, Belgium); Lafontaine, I.; Augin, B.; Gilles, P. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The study was performed in three successive phases. The first phase, achieved in 1981, covered the following subjects: bibliographic research of the data relating to the deceleration forces, generated during accidents with road- and rail-road conveyances; information requests to the manufacturers of road trucks, institutions for mechanical studies, transport companies, rail-road companies, transport authorities in order to complete the bibliographic data; and analysis of the obtained information and first conclusions. The second phase, achieved in November 1982, covered the following subjects: analysis of statistical data concerning truck accidents in order to define reference types of accidents, impact speed and -direction etc.; comparison between performed crash-tests in order to obtain reference data of generated forces and deceleration values; definition of an experimental programme to be performed in a third phase; and definition of the instrumentation required for the experimental programme. The third phase, ending in October 1983, was the experimental part of the study. The data, collected during the first two phases, were checked by real crash tests, to be performed at the U.T.A.C. laboratories in France. Both the theoretical data and the test results will be used to write a proposal of a code of good practice for stowing and tie-downs.

25470 (CONF-830528—Vol.2, pp 1548-1551) **Design rules for containment systems of nuclear spent fuel and high-level waste transport packagings.** Nickell, R.E. (Electric Power Research Inst., Palo Alto, CA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Some of the topics discussed are: service conditions/limits, design/test conditions/limits, classification of stresses; and inelastic analysis.

25471 (CONF-830528—Vol.2, pp 1607-1612) **Problems in educational training: number and type of workers involved in the transport of radioactive materials.** Faloci, C. (ENEA-DISP, Rome, Italy). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The aim of this work is to analyze the various transport phases and the different situations which might occur to enlighten the role of the workers and then to define what are the real needs in the field of training of the workers. 2 tables.

25472 (CONF-830528—Vol.2, pp 1613-1615) **Compliance training.** Reed, H.C. (Science Applications, Inc., Oak Ridge, TN). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The Department of Energy's compliance training program is described.

25473 (CONF-830528—Vol.2, pp 1616-1619) **Radioactive material transportation information program.** Taynton, L.F. (Science Applications, Inc., Oak Ridge, TN); Blalock, L.G. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

We are working closely with DOE's field traffic managers to help develop useful public information materials because these managers are familiar with ongoing problems in their areas of operation. In addition, proposals are being prepared to make use of existing traveling exhibitry and to have personnel available to respond immediately to incidents. A close working relationship between traffic managers and state legislators is being cultivated to ensure that new legislation is based on fact. It is our intent to help inform the American public that an excellent track record has been established for transporting radioactive materials and that the transportation industry can be trusted to maintain this record of safety.

25474 (CONF-830528—Vol.2, pp 1628-1632) **Radioactive Material Transportation (RAMT) data base: a study of industry shipments.** Lyman, T.R. (SRI International, Menlo Park, CA); McClure, J.D. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The major objectives of the RAMT study are to collect data on the shipment of radioactive material (other than weapons shipments) in the United States, to develop a comprehensive data base organizing this information into a readily retrievable format and to generate quantitative descriptions of these shipments. The status of this study is reported.

25475 (CONF-830528—Vol.2, pp 1633-1638) **Regulation versus reality.** Jefferson, R.M.; McClure, J.D. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A brief history of radioactive waste transport regulations is given.

25476 (EUR—8254) **Catalogue of facilities in Member States of the European Community for testing the packaging of radioactive materials.** Marchal, A.; Swindell, G.E. (Commission of the European Communities, Luxembourg). 1983. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84700941.

A group of experts convened by the Commission of the European Communities in Brussels on 2 July 1980 to suggest possible actions in connection with the safe transport of radioactive materials, recommended, among other things, that the Commission should collect and distribute information on packaging test facilities in Member States. In response to that recommendation a letter of enquiry was sent informally, on behalf of the Commission, to the competent authorities of the Member States. The purpose of the enquiry is to assist in the effective implementation of the internation-

ally accepted Regulations for the Safe Transport of Radioactive Materials through the dissemination of information on test facilities and on the terms and conditions under which the services of these facilities could be made available for the testing of packaging designed in other countries. As an aid to the presentation of the material in a harmonized format, it was suggested that the information provided should cover relevant topics. The information received by the Commission has been assembled for each installation according to this format.

25477 **(GA-A—17292) OLDAGE, a computer program for calculating nuclear fuel cycle flow balances. Monitored Retrievable Storage study. FY-83 studies. Task C.** Ligon, D.M.; Harris, P.A. (GA Technologies, Inc., San Diego, CA (USA)). Sep 1983. Contract AT03-81SF11528. 65p. NTIS, PC A04; 3; GPO Dep. Order Number DE84010942.

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OLDAGE is a computer program used to calculate the amount of spent fuel and/or HLW transferred to and from the various fuel cycle facilities (i.e., reactors, reprocessing, MRS, or repository) within the nuclear waste management system. OLDAGE analyzes the logistics of transporting and storing spent fuel and high-level waste among fuel cycle facilities using the priority rule of oldest fuel/waste first. The transfer of spent fuel/HLW from one location to the other is limited by the handling capacity of each location. Although the program has the potential for a wide range of applications, the purpose for its development was to provide the material flow balance input for another program, CASMO. CASMO is used to calculate the total miles for one or more MRS sites based on the amount of fuel transferred into and out of the MRS, and the corresponding transportation costs for specific MRS sites. The results produced by executing OLDAGE provide a decision tool to aid in planning and scheduling spent fuel/HLW shipments, siting MRS facilities, determining at-reactor storage capacity requirements, handling rates, and needed facility start-up dates. 2 references, 2 figures.

25478 **(PNL-SA—11685) Simulation of the MRS receiving and handling facility.** Triplett, M.B.; Imhoff, C.H.; Hostick, C.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 16p. (CONF-840307—26). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008678.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

Monitored retrievable storage (MRS) will be required to handle a large volume of spent fuel or high-level waste (HLW) in case of delays in repository deployment. The quantities of materials to be received and repackaged for storage far exceed the requirements of existing waste mangement facilities. A computer simulation model of the MRS receiving and handling (R and H) fcility has been constructed and used to evaluate design alternatives. Studies have identified processes or activities which may constrain throughput performance. In addition, the model has helped to assess design tradeoffs such as those to be made among improved process times, redundant service lines, and improved component availability. 1 reference, 5 figures.

25479 **(PNL-SA—12022) Implementation of DOE's spent fuel program: a first anniversary report.** Newman, D.F.; Cole, B.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 5p. (CONF-840307—27). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008662.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

The instrument for carrying out Department of Energy (DOE) actions with respect to spent fuel in the next decade and a half will be the Commercial Spent Fuel Management Program. This paper reviews the accomplishements of the CSFM Program in the last year, the status of ongoing activities, and the schedule for the availability of dry storage and rod consolidation as licensed options for utility deployment. The plans and strategy for meeting DOE's obligations, stemming from the Nuclear Waste Policy Act (NWPA), are described. These cover performing cooperative licensed demonstrations of dry storage and rod consolidation technologies with utilities, conducting spent fuel R and D to expedite utility licensing efforts for these new technologies, and implementing Federal Interim Storage as needed. 10 references, 4 figures.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 26102

0520 Waste Management

REFER ALSO TO CITATION(S) 25404, 25419, 25423, 25440, 25478, 25532, 25533, 25568, 25572, 25573, 26425, 26622, 27056

25480 **(AERE-G—2665) Programme of research into the management and storage of radioactive waste. Nuclide migration and mathematical modelling.** Bourke, P.J.; Bradbury, M.H.; Evans, G.V. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). May 1983. 29p. (DOE-RW—83.022). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700975.

The experimental programme on radionuclide behaviour has included (a) the influence of silica colloids on the nature and sorption properties of actinide solutions, (b) the properties of Np and Tc leached from simulated high level radioactive wastes, and (c) the behaviour in the presence of various geological media of leachates arising from intermediate level radioactive wastes encapsulated in concrete. Diffusion measurements, using the iodide ion as tracer, have been made on granites obtained from four different regions of the UK. Analysis of the data has yielded three important rock diffusion parameters, the intrinsic diffusion coefficient, the rock capacity factor and the rock diffusibility parameter. In addition, estimates for the through transport and storage porosities which together make up the total porosity can be obtained from the same data. Permeability measurements made on granite and sandstone have been used to calculate pore apertures and pore internal surface areas. A study of uranium series disequilibrium signatures (uranium content and activity ratios U-234/U-238, Th-230/U-234 and Th-230/Th-232) in waters in granite at Altnabreac, Caithness, has been completed. The main areas of mathematical modelling described are continuum models of groundwater flow, heat transfer and radionuclide transport, flow in fracture networks, and diffusion of radionuclides into the rock matrix.

25481 (ANL—83-55, pp 92-107) **Nuclear fuel cycle research.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The Chemical Technology Division's (CMT) fuel cycle program is engaged in (1) investigations of the leaching that might occur from waste forms in geologic formations, (2) geochemistry studies of trace-constituent migration in the earth's crust due to groundwater flow, and (3) examination of nuclear-waste disposal schemes for the Nuclear Regulatory Commission. In addition, CMT is participating in DOE's program to develop the technology for breeding in a light water reactor.

25482 **(ANL—83-78) Fuel cycle programs. Quarterly progress report, April-June 1983.** Steindler, M.J. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011429.

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Waste management studies include concepts for management of nuclides produced by fuel reprocessing, modification of nuclear waste repository backfill materials, laboratory analog experiments, transport of trace elements in lithic materials, and development of a test procedure to investigate the reaction of nuclear waste glasses with water. The backfill studies involve the physical properties of bentonites, alteration of backfill materials under the severe conditions expected in a repository, and hydrothermal experiments on candidate backfill materials. The analog experiments use models of fluid flow, nuclide reaction, and particulate suspension to examine the consequences of breaching of a repository by flowing ground-

water. The assessment of trace-element transport involves studies of phenols in a dolomite environment and the effects of dissolved organic matter on the migration of neptunium and americium through granulated basalt. Development work for the destructive analyses of full-length irradiated fuel rods is in progress. Current activities concern the development, installation, testing, and qualification of a full-scale shear, a dual dissolver, and other equipment and systems. Studies concerning fusion reactor development include the recovery of tritium, management of fusion waste materials, solid and liquid breeder blankets, and tritium processing systems. Preliminary results of a tritium recovery experiment have been obtained. Shallow land burial of structural materials used with lithium blankets is considered feasible provided the lithium has been removed and other metal content is controlled. Additional work includes a thermal hydraulic analysis of solid blankets and an evaluation of tritium recovery techniques for liquid blankets. Design support work on tritium systems for mirror and tokamak reactor designs is under way, and public radiation dose and accident probabilities have been assessed. 42 figures, 43 tables.

25483 **(ANS—325) Underground disposal of vitrified high level radioactive waste: a review of research and development.** (Associated Nuclear Services, London (UK)). Nov 1982. 216p. (DOE-RW—82.109). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84700978.

A review has been undertaken of the worldwide status of research and development related to the geological disposal of vitrified high level radioactive waste. The nature and quantities of vitrified high level waste that will arise from nuclear power generation in the UK have been estimated and considered. The safety case for establishing a geological repository would have to be based on predictive models, which could adequately represent the interactions and effects of a wide range of gradual processes and possible sudden events. No detailed repository design has yet been published, but the configuration currently favoured, in the UK and in most other countries, comprises a small number of vertical shafts, from which a network of horizontal tunnels would be excavated. Waste packages would be placed in holes drilled in the floors of the tunnels. The excavation of such a repository in hard crystalline rock, in a thick homogeneous formation of rock salt, or in the less plastic argillaceous formations, appears to be within the scope of present technology. Rock types available in the UK, which are likely to prove suitable for the accommodation of a repository, have been identified. The strategies and programmes for high level waste disposal in other countries have been reviewed.

25484 **(BMI/ONWI—9(83-3)) Management activities for the DOE's National Waste Terminal Storage Program. Technical progress report for the quarter 1 April-30 June, 1983.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1983. Contract AC02-83CH10140;AC06-76RL01830. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010584.

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This report describes the technical accomplishments during the period from April through June, 1983, on the commercial nuclear waste management programs under the direction of the U.S. Department of Energy, National Waste Terminal Storage Program Office (NPO), Office of Nuclear Waste Isolation (ONWI). The ONWI program is organized into the following eight tasks, each one being a level-two element of the ONWI Contract Work Breakdown Structure (CWBS): (1) systems; (2) waste package; (3) site; (4) repository; (5) regulatory and institutional; (6) test facilities and excavations; (7) land; and (8) program management. This report reviews progress on the following tasks: (1) systems; (2) waste package; (3) site which covers generic data, Permian Basin data, Paradox Basin data, Gulf Coast salt dome basin data; (4) repository; (5) regulatory and institutional; and (6) test facilities and excavations.

25485 **(BMI/ONWI—492) Seismicity of the Paradox Basin and the Colorado Plateau interior.** Wong, I.G. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Apr 1984. Contract AC02-83CH10140. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011620.

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National Waste Terminal Storage Program site qualification criteria require that a nuclear waste repository be located so that ground motion associated with the maximum credible and maximum probable earthquakes or other earthquake-associated effects will not have an unacceptable adverse impact on system performance. To determine whether a potential repository site located in the Paradox salt formation in the Paradox Basin of southeastern Utah satisfies these criteria, seismological studies were undertaken by Woodward-Clyde Consultants (WCC) in March 1978. These studies included: (1) analysis of historical seismicity; (2) analysis of contemporary seismicity and tectonics of both the Paradox Basin and surrounding Colorado Plateau, including an extensive program of microearthquake monitoring; (3) evaluation of the Paradox Basin crustal structure; (4) evaluation of mining-induced seismicity; and (5) characterization of design-related earthquake-induced ground motions pertinent to a potential repository site through studies of attentation and subsurface ground motions. A detailed discussion of the results of the seismological studies performed through December 1980 is contained in WCC (1982). The purpose of this topical report is to update and summarize the studies on the local, regional, and mining-induced seismicity conducted through December 1982. The limitations of any interpretations are also discussed and additional information that remains to be acquired is identified. 56 references, 45 figures, 4 tables.

25486 **(BMI/ONWI—502) First status report on regional and local ground-water flow modeling for Richton Dome, Mississippi.** Andrews, R.W.; Metcalfe, D.E. (INTERA Environmental Consultants, Inc., Houston, TX (USA)). Mar 1984. Contract AC02-83CH10140. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010927.

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Regional and local ground-water flow within the principal hydrogeologic units in the vicinity of Richton Dome is evaluated by developing conceptual models of the flow regime within these units at three different scales and testing these models using a three-dimensional, finite-difference flow code. Semiquantitative sensitivity analysis is conducted to define the system response to changes in the conceptual model, particularly the hydrologic properties. The effects of salinity on the flow field are evaluated at the refined and local scales. Adjoint sensitivity analysis is applied to the conceptualized flow regime in the Wilcox aquifer. All steps leading to the final results and conclusions are incorporated in this report. The available data utilized in this study is summarized. The specific conceptual models, defining the areal and vertical averaging of lithologic units, aquifer properties, fluid properties, and hydrologic boundary conditions, are described in detail. The results are delineated by the simulated potentiometric surfaces and tables summarizing areal and vertical boundary fluxes, Darcy velocities at specific points, and ground-water travel paths. These results are presented at regional, refined, and local (near-dome) scales. The reported work is the first stage of an ongoing evaluation of the Richton Dome as a potential repository for high-level radioactive wastes. The results and conclusions should thus be considered preliminary and subject to modification with the collection of additional data. However, this report does provide a useful basis for describing the sensitivity and, to a lesser extent, the uncertainty of the present conceptualization of ground-water flow in the vicinity of Richton Dome. 25 references, 69 figures, 15 tables.

25487 **(BMI/ONWI—525) Potentiometric-level monitoring program - Mississippi and Louisiana: annual status report for fiscal year 1983.** (Battelle Columbus Labs., OH (USA)). Mar 1984. Contract AC02-83CH10140. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012023.

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Potentiometric-level data presented in this report were collected from October 1982 to September 1983 at 62 wells in Mississippi and Louisiana near Richton and Vacherie Domes, respectively. Six wells were added to the monitoring program during this period, and one previously measured well was damaged and has been deleted from the monitoring program. Analysis of the data indicates that most of the potentiometric-level changes recorded during fiscal year 1983 were small (less than 2 feet) and attributable

to seasonal fluctuations. Of the 62 wells monitored, 18 exhibited potentiometric-level changes in excess of 2 feet. In Mississippi, the data generally indicate that a long-term, potentiometric-level increase is occurring in the Sparta, Kosciusko, Hattiesburg, Wilcox, and Citronelle Formations. Only seasonal fluctuations in potentiometric levels were observed in the caprock, and in the Catahoula and Cockfield Formations. In Louisiana, a long-term, potentiometric-level decline was observed for the Lower Austin Formation while an increase was observed for the Sparta and Upper Austin Formations. Seasonal fluctuations were observed in the Wilcox, Carrizo, and Nacatoch Formations. This work is a continuation of that described in ONWI-478 for fiscal year 1982. 24 references, 2 figures, 3 tables.

25488 **(BMI/ONWI—527) Meteorological and air quality characterization of the Deaf Smith and Swisher County locations in the Palo Duro Basin, Texas.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1984. Contract AC02-83CH10140. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010625.

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The meteorological and air quality characteristics of the Permian Basin locations in Deaf Smith County and Swisher County, Texas, are described using data from eight climatological stations in the vicinity. Meteorological conditions are reasonably represented by these data because of the generally flat terrain over the area and the geographical proximity of the climatological stations to the locations. Information regarding atmospheric transport and dispersion conditions is derived from data for the period 1976 to 1980 provided by the National Weather Service station at Amarillo, Texas. On an annual basis, southerly winds predominate and the average wind speed is 6.1 m/s (13.7 mph). The analysis of dispersion climatology indicates that neutral atmospheric stability also predominates over the year. This, in combination with high average wind speeds, is characteristic of relatively good dispersion conditions in the area. Significant topographic features are far enough away from the locations that their effects on local dispersion conditions are negligible. The closest available air quality data were collected around population centers and may not accurately represent conditions at these rural and undeveloped locations. The area has been declared "attaining" for particulate and sulfur dioxide standards and "cannot be classified as better than ambient standard" for nitrogen oxides, ozone, and carbon monoxide. 49 references, 5 figures, 18 tables.

25489 **(BNL-NUREG—34596) Geochemistry of trench leachates at low-level radioactive waste burial sites.** Dayal, R.; Pietrzak, R.F.; Clinton, J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-8405144—1). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010800.

From International groundwater symposium; Montreal, Quebec, Canada (21 May 1984).

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Trench leachates from the low-level radioactive waste burial sites at Maxey Flats, Kentucky and Barnwell, South Carolina were sampled and analyzed for dissolved inorganic, organic, and radionuclide constituents. Relative to local groundwaters, the trench leachates exhibit significant modifications in major ion and radionuclide compositions. The formation and composition of the leachates can be attributed to site-specific hydrological and geochemical factors. Leaching and microbial degradation of waste materials are considered to be the important geochemical processes controlling the leachate compositions. Elevated concentrations of Na, K, Ca, Mg, Cl, dissolved organic and inorganic carbon, and various anthropogenic radionuclides reflect leaching of waste materials. Anoxic conditions as characterized by depletion of dissolved oxygen and sulphate, and high contents of alkalinity and ammonia reflect microbial decomposition of organic waste materials. Because of relatively stagnant water accumulations, the extent of modification is much greater in the Maxey Flats leachates as compared with those from Barnwell. 8 references, 2 figures, 2 tables.

25490 (CONF-830528—Vol.1, pp 207-214) **Module container system for LLW disposal.** Viecenz, H.J.; Krieger, F. (Gg. Noell GmbH, Wuerzburg, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

With regard to the final storaging of metallic LLW from decommissioning projects, packaging into box type containers shows a variety of advantages compared to the raditionally used drum types. The design of a module container system presented herein is in line with German and IAEA requirements for transportation and final storaging into a mine. Special regard was given to the waste activity and packaging process and results in a decision chart to facilitate the selection of the appropriate container type according to the job specific necessities. 3 references, 7 figures.

25491 (CONF-830528—Vol.1, pp 215-223) **Low-cost/high-integrity waste casks.** Rittscher, D. (Gesellschaft fuer Nuklear-Service, Essen, Germany); Schilling, H.; Glaser, H.; Dybeck, P. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The MOSAIK cast iron casks for storage and transportation of waste have the following advantages: much higher activity content with a lower total volume compared with concrete waste packages; good shielding in connection with automated filling or underwater loading techniques leads to dose exposure reduction of the operating personnel; high cask integrity guarantees a tight containment and makes an additional fixation of the waste in the cask cavity unnecessary; and the low serial production costs of cast iron casks and the resulting volume reduction using these casks lead to a cost advantage under German licensing conditions. 5 figures.

25492 (CONF-830528—Vol.1, pp 399-404) **Isotopic analysis of radioactive waste packages (an inexpensive approach).** Padula, D.A.; Richmond, J.S. (Kewaunee Nuclear Power Plant, WI). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A computer printout of the isotopic analysis for all radioactive waste packages containing resins, or other aqueous filter media is now required at the disposal sites at Barnwell, South Carolina, and Beatty, Nevada. Richland, Washington requires an isotopic analysis for all radioactive waste packages. The NRC (Nuclear Regulatory Commission), through 10 CFR 61, will require shippers of radioactive waste to classify and label for disposal all radioactive waste forms. These forms include resins, filters, sludges, and dry active waste (trash). The waste classification is to be based upon 10 CFR 61 (Section 1-7). The isotopes upon which waste classification is to be based are tabulated. 7 references, 8 tables.

25493 (CONF-830528—Vol.1, pp 405-412) **Development of waste package designs for disposal in a salt repository.** Balmert, M.E. (Office of Nuclear Waste Isolation, Columbus, OH). Dec 1983. NTIS, PC A99/MF A01. Contract AC06-76RL01830.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Three package design concepts were developed for CHLW and DHLW forms and spent fuel rods: (1) carbon steel overpack, borehole emplacement, (2) titanium clad, carbon steel reinforced overpack, borehole emplacement, and (3) carbon steel (self-shield) overpack, tunnel emplacement. For a DHLW canister with titanium clad overpack, the concept features a 9.5-cm-thick carbon steel overpack reinforcement supporting a 0.25-cm-thick titanium shell. The overall package dimensions are 84 cm diameter x 340 cm long weighing about 8.8 mtons. By contrast, a monolithic DHLW borehole package has a carbon steel overpack that is 10.4 cm thick, weighing about 9.3 mtons. The titanium clad/carbon steel reinforced borehole package is intended for remote emplacement in a vertical borehole in salt. The carbon steel overpack reinforcement provides structural integrity, primarily to resist external pressure,

while the titanium overpack provides the necessary corrosion resistance to meet containment requirements. The carbon steel borehole package concept provides containment integrity for both external pressure and corrosion environments with a thicker carbon steel overpack in place of the titanium/carbon steel concept. A third concept utilizes an even greater thickness of cast steel or iron to resist external pressure and corrosion as well as reduce external shielding requirements. For example, a cast steel DHLW package would have overall dimensions of 125 cm diameter x 390 cm long, weighing 31 mtons. The purpose of this self-shield concept is to minimize handling and emplacement operations by reducing the package surface radiation dose to about 100 mrem/hr. In addition, it may serve as a shipping cask, thereby eliminating the need for a shielded hot cell at the repository for waste package assembly operations. 7 figures.

25494 (CONF-830528—Vol.1, pp 500-507) **Radwaste receiving and handling facility for mine disposal.** Viecenz, H.J.; Krieger, F. (Gg. Noell GmbH, Wuerzburg, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper deals with the overall layout of a radwaste receiving and handling facility and design of equipment necessary for safe and regular radwaste handling from its arrival at the plant to its delivery to the shaft. 1 reference, 8 figures, 3 tables.

25495 **(CONF-8403108—1) Use of SAS in the IDB.** Morrison, G.W.; Notz, K.J.; Mastal, E.F.; Trice, V.G. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02; 3; GPO Dep. Order Number DE84008521.

From SUGI conference; Hollywood, FL, USA (18 Mar 1984).

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The Integrated Data Base (IDB) Program provides official US Department of Energy (DOE) data on spent fuel and radioactive waste inventories, projections, and characteristics. This information is provided through the cooperative efforts of the IDB Program and DOE lead offices, lead sites, major programs, and generator sites. The program is entering its fifth yeaar, and major accomplishments are summarized in three broad areas: (1) the annual inventory report, including ORIGEN2 applications and a Quality Assurance (QA) plan; (2) the summary data file and direct user access; and (3) data processing methodology and support to other programs. Plans for future work in these areas are outlined briefly, including increased utilization of personal computers. Some examples of spent fuel data are given in terms of projected quantities for two growth scenarios, burnup and age profile of the existing inventory, and the approximate specific thermal power relative to high-level waste (HLW) from various sources. 2 references, 3 figures.

25496 **(DOE-RW—83.084) Currents in the Eastern Irish Sea.** Howarth, M.J. (Institute of Oceanographic Sciences, Birkenhead (UK). Bidson Observatory). 1983. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84700979.

Low level radioactive waste is discharged from the nuclear reprocessing plant at Sellafield, Cumbria. Its movement away from the discharge point is determined by the Irish Sea's dynamics, both for the soluble compounds and for those compounds which become attached to the sediment. Near Sellafield the tidal currents are weak and parallel to the shore, becoming stronger east/west to the north and south of the Isle of Man. Wind driven currents near Sellafield are predominantly north-westward, strongest near the coast, and oppose the other low frequency currents. Hence, the soluble effluent will initially be dispersed parallel to the shore by the weak tidal currents, moving episodically, southeastward during weak winds and northwestward during storms. Eventually it will leave the Irish Sea, flowing northward through the North Channel.

25497 **(DP—1662) Development of a slurry-fed in-can melter for nuclear defense waste.** D'Entremont, P.D.; Wolf, H.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Dec 1983. Contract AC09-76SR00001. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010670.

A full-scale, nonradioactive process has been studied in which a slurry of waste sludge and glass formers is fed to a heated can. Saturated steam is used to cool the off-gas. Initial results show the concept to be technically adequate. 2 references, 8 figures, 4 tables.

25498 **(DP-MS—83-94) Costs for disposal of Savannah River high-level waste in a commercial repository.** McDonell, W.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1984. Contract AC09-76SR00001. 9p. (CONF-840307—32). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011135.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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Costs of SRP high-level waste disposal were projected using baseline conceptual designs for commercial nuclear waste repositories to accommodate defense waste packages in an augmented repository mode. For 10,000 SRP waste canisters emplaced in conjunction with spent fuel and commercial processed waste in salt, tuff, and basalt repositories, the defense high-level wastes (DHLW) would occupy an underground repository area 5 to 7% of that committed to commercial high-level wastes. Direct costs representing incremental expenditures for DHLW disposal in the commercial waste repositories depended on repository geology, waste packaging requirements, and underground emplacement patterns. For a representative repository utilizing steel overpacks on emplaced canisters, direct costs of SRP waste disposal would be about $580 million, with a major fraction ($51,500/canister) directly proportional to the number of canisters emplaced. Indirect costs representing allocated charges for DHLW use of repository facilities in common with commercial wastes were estimated for the basalt repository at about $245 million, bringing total repository costs for SRP waste disposal to about $825 million. Elimination of overpack requirements would reduce the SRP repository costs by about $220 million. 10 references, 2 figures, 7 tables.

25499 **(EGG—2292) Decontamination and decommissioning of the TAN/TSF-3 concrete pad. Final report.** Smith, D.L.; Wisler, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 34p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010583.

This report describes the decontamination and decommissioning (D and D) of the TAN/TSF-3 concrete pad at the Idaho National Engineering Laboratory (INEL). This pad became contaminated in the 1960s and had been roped off until the 1983 decommissioning. The report includes radiological characterization of the pad area before D and D, after D and D, and after backfilling and grading. To accomplish the selected alternative of completely removing the concrete and contaminated soil, the pad was sawed into sections; the concrete and surrounding soil were boxed and shipped to the Radioactive Waste Management Complex for burial. The excavated area was then backfilled and graded. Soil samples collected and analyzed as well as radiation fields measured after D and D yielded results that permit the area to be released for further use at INEL for equipment storage, or some other appropriate use. 5 references, 20 figures, 6 tables.

25500 **(EUR—7415) Encapsulation pilot plant of radioactive wastes in thermosetting resins. Final report.** (Commission of the European Communities, Luxembourg). 1982. 46p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700976.

The thermosetting resins (polyesters, epoxides) are used to encapsulate the low- and intermediate-level radioactive wastes. The testing program concerning the drums produced by the pilot plant of the Chooz nuclear power plant is described. The installation operating is examined while thinking of the industrial application. The production costs are then evaluated.

25501 **(EUR—7822) Behaviour of the gaseous radionuclides released during the first reprocessing operations.** Leudet, A.; Leseur, A. (Commission of the European Communities, Luxembourg). 1982. 62p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700910.

The results obtained during shearing and dissolution of five fuel pins irradiated in the PWR BORSSELE (Netherlands) are reported. The iodine, tritium, xenon, krypton and carbon 14 quantities enclosed in each reprocessed fuel pin have been determined by means of accurate analysis in the gaseous effluents. This results are compared with expected amounts obtained by prior calculations after determination of the burn-up. This work allows to set up the behaviour of the gaseous radionuclides for the operative conditions of our experiments.

25502 **(EUR—8186) Underground disposal for radioactive wastes: study of the thermal impact in a fractured medium.** Coudrain, A.; Hosanski, J.M.; Ledoux, E.; Vouille, G. (Commission of the European Communities, Luxembourg). 1982. 181p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84700984.

Radioactive waste storage in deep geologic formations, like granitic rocks, is one of the solutions studied for long-life radioactive wastes disposal. The study presented in this document has been developed in five stages: (1) theorical analysis of heat transfer in a fractured medium; (2) bench-scale experiments to study the convection in an artificial fracture with a punctual heat source; (3) bench-scale experiments to study convection in a real fracture with a spread heat source; (4) influence of the thermal stresses on the permeability of a fracture; (5) and finally, the mathematical model, validated in laboratory, used to simulate water and heat transfer, allows to discuss the radionuclides migration from an hydrodynamical point of view.

25503 **(EUR—8424) Testing and evaluation of solidified high-level waste forms. Joint annual progress report. Final report.** De Batist Al, R. (Commission of the European Communities, Luxembourg). 1983. 127p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84700985.

In addition to the preceding programme of the European Atomic Energy Community two new borosilicate glass compositions have been introduced. The chemical stability of these waste forms, in particular with respect to geological disposal conditions, is examined as well as effects of alpha-radiation and of devitrification. Leaching studies include theoretical and experimental investigations of the basic leaching mechanisms, the measurement of the leach rates of a number of critical radioisotopes and the influence on the leach rate of various parameters such as temperature, pressure pH and duration. Of particular interest is the simulation of repository conditions. Prelimimary results are described related to various mineral waters, granite and salt solutions. The surface layers generated on the waste forms during corrosion are investigated in detail using various experimental techniques such as scanning electron microscopy, X-ray analysis and alpha particle energy loss spectra measurements. The radiation stability was further tested by continuing investigations of the samples doped with ^{238}Pu in the course of the previous programme; density and leach rate variations were measured. Effects on the leach rate of devitrification resulting from various heat treatments of active glass samples were also investigated.

25504 **(GA-A—17322) Monitored Retrievable Storage conceptual system studies: closed-cycle vault.** Washington, J.A.; Ganley J.T. (GA Technologies, Inc., San Diego, CA (USA)). Feb 1984. Contract AT03-81SF11528. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011023.

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The Nuclear Waste Policy Act of 1982 requires the DOE to submit a proposal to Congress by June 1985 for the construction of one or more Monitored Retrieval Storage (MRS) facilities. In response, the DOE initiated studies to develop system descriptions and cost estimates for preconceptual designs of storage concepts suitable for use at MRS facilities. This report provides a system description and cost estimates for a Closed-Cycle Vault (CCV) MRS facility. The facility description is divided into four parts: (1) the R and H area, (2) the interface facility, (3) the on-site transport system, and (4) the storage system. The MRS facility has been designed to meet handling rates of 1800 and 3000 MTU/yr. The corresponding peak inventories are 15,000 and 72,000 MTU. Three types of cases were considered, based on the material to be stored: (1) Spent fuel only; (2) HLW and TRU waste; and (3) HLW only. For each of these three types, a cost estimate was done for a 15,000 and a 72,000 MTU facility, resulting in six different cost estimates. Section 4 presents the cost analysis of the CCV MRS system. Tables 4-2 through 4-7 give the construction or capital costs for the six cases. Tables 4-8 through 4-13 show the total discounted life-cycle costs for each of the six cases. These life-cycle costs include operating and decommissioning costs. These tables also show the time distribution of the capital costs. Table 2-1 summarizes the capital, operating, and discounted costs for the six cases studied. 2 references, 15 figures, 18 tables.

25505 **(GA-A—17391) Annotated bibliography of the GA Technologies Inc. MRS program.** (GA Technologies, Inc., San Diego, CA (USA)). Apr 1984. Contract AT03-81SF11528. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011026.

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This report provides abstracted descriptions of all published technical milestone documents produced by GA Technologies Inc.'s Monitored Retrieval Storage (MRS) staff since the inception of its program participation. Additional unpublished milestone documents were delivered to the DOE during the program.

25506 **(LA—9916-MS) Geotechnical aspects of hackroy sandy loam and crushed tuff.** Abeele, W.V. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011009.

Important geotechnical properties that should be tested before construction and operation of a low-level waste disposal site include hydraulic conductivity, consolidation, and shear strength of the soils of interest in that low-level waste disposal site. Because hydraulic conductivity of Bandelier tuff and adjacent soils has been the subject of exhaustive studies, this report will concentrate on consolidation and shear stress of the above-mentioned porous media. 9 references, 11 figures, 7 tables.

25507 **(MLM—3144) Glass furnace project: March-September 1983.** Armstrong, K.M.; Klingler, L.M.; Lewis, E.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 30 Apr 1984. Contract AC04-76DP00053. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011014.

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A commercially available joule-heated glass furnace system is currently being evaluated at Mound as a means of processing low-level radioactive wastes typically found in light water reactor facilities. This evaluation has been primarily concerned with determining the effectiveness of the processing technique for volume reduction and immobilization. The first phase of the evaluation consisted of a series of nonradioactive experiments to determine the combustion efficiency of the furnace and chemical durability of the glass for several waste types deemed representative of power plant effluent streams. Upon completion of this work, radioactive spiked experiments were initiated to provide, when completed, a comprehensive mass balance and to establish volatility trends for several predominant radioisotopes. 6 references, 15 figures, 13 tables.

25508 **(NUREG/CR—2614) Identification of characteristics which influence repository design: tuff. Final report (Task 1), June 1981-March 1982.** Rawlings, G.; Antonnen, G.; Findley, D.; Hoffmann, R.; Soto, C.; Rowe, J.; Marinelli, F.; Roberds, W.; Pentz, D.; Jones, K. (Golder Associates, Inc., Bellevue, WA (USA)). Apr 1984. 157p. NTIS, PC A08/MF A01 - GPO* $6.00. Order Number DE84900939.

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The purpose of the complete project is to provide NRC with technical assistance to enable the focused, adequate review by NRC of the aspects related to design and construction of an underground test facility and final geologic repository as presented by the Department of Energy (DOE). The study presented in this report covers the identification of characteristics which influence design and construction of a geologic repository in tuff at the Nevada Test Site (NTS). This report has identified five key issues, i.e., constructibility, thermal response, mechanical response, hydrological response, and geochemical response. This report involves both short-term (up to closure) and long-term (post closure) effects. The characteristics of tuff and its environment are described under the headings of stratigraphic/structual tectonic, mechanical, thermal and hydrologic. Characteristics are separated into parameters (quantified and measured) and factors (qualitative). The characteristics are then subjectively ranked by their influence on the key issues. This ranking took into account availability and suitability of conservative design/construction techniques, uncertainty in model and the model sensitivity to characteristics. 65 references, 39 figures, 13 tables.

25509 **(NUREG/CR—3218) Evaluation of engineering aspects of backfill placement for high level nuclear waste (HLW) deep geologic repositories.** Roberds, W.; Kleppe, J.; Gonano, L. (Golder Associates, Inc., Bellevue, WA (USA)). Apr 1984. 515p. NTIS, PC A22/MF A01 - GPO* $19.00. Order Number DE84901152.

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This report includes the identification and subjective evaluation of alternative schemes for backfilling around waste packages and within emplacement rooms. The aspects of backfilling specifically considered in this study include construction and testing; costs have not been considered. However, because construction and testing are simply implementation and verification of design, a design basis for backfill is required. A generic basis has been developed for this study by first identifying qualitative performance objectives for backfill and then weighting each with respect to its potential influence on achieving the repository system performance objectives. Alternative backfill materials and additives have been identified and evaluated with respect to the perceived extent to which each combination can be expected to achieve the backfill design basis. Several distinctly different combinations of materials and additives which are perceived to have the highest potential for achieving the backfill design basis have been selected for further study. These combinations include zeolite/clinoptilolite, bentonite, muck, and muck mixed with bentonite. Feasible alternative construction and testing procedures for each selected combination have been discussed. Recommendations have been made regarding appropriate backfill schemes for hard rock (i.e., basalt at Hanford, Washington, tuff at Nevada Test Site, and generic granite) and salt (i.e., domal salt on the Gulf Coast and generic bedded salt). 27 references, 8 figures, 31 tables.

25510 **(NUREG/CR—3427-Vol.3) Long-term performance of mateials used for high-level waste packaging. Third quarterly report, year two, October 1983-December 1983.** Miller, S.N.E.; Stahl, D.; Miller, N.E. (comps.). (Battelle Columbus Labs., OH (USA)). Mar 1984. 99p. NTIS, PC A05/MF A01 - GPO* $4.75. Order Number DE84900968.

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As part of the Nuclear Regulatory Commission's effort to assess the Department of Energy's application to construct geologic repositories for high-level radioactive waste, Battelle's Columbus Laboratories is investigating the long-term performance of materials used for high-level waste packages. Data from preliminary glass leaching experiments were analyzed, and methods for leachate analysis were developed. Testing conditions were determined for the leaching pilot experiment, and a flow chart for devitrification calculations was developed. Methods for evaluating spent fuel and radiation effects were reviewed. Experiments in the internal corrosion task were essentially completed and data analysis continues. External corrosion studies indicated low general corrosion rates for the canister; howver, some relatively deep pits were found on one specimen in the vapor phase. Further experiments will be conducted. Electrochemical studies indicate that steel can passivate and become susceptible to localized corrosion in basaltic groundwater. Fracture toughness tests of cast and wrought low carbon steels in nitrogen and hydrogen were initiated. Hydrogen reduced the tearing modulus of the steel. Hydrogen absorption in cast and wrought steels in basaltic environments is being evaluated. Results of comptuer simulations of groundwater radiolysis were compared with results from the general-corrosion correlation. Gamma energy deposition was calculated from commercial high-level waste. Efforts in correlation developmet focused on pitting corrosion and water chemistry with emphasis on pit-growth kinetics. A quality assurance program audit was initiated. This report documents investigations performed during October to December, 1983. 28 references, 19 figures, 31 tables.

25511 **(NUREG/CR—3533) Radon attenuation handbook for uranium mill tailings cover design.** Rogers, V.C.; Nielson, K.K.; Kalkwarf, D.R. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Apr 1984. Contract AC06-76RL01830. 87p. (PNL—4878; RAE—18-5). NTIS, PC A05/MF A01; 1 - GPO $4.50; GPO Dep. Order Number DE84011549.

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This handbook has been prepared to facilitate the design of earthen covers to control radon emission from uranium mill tailings. Radon emissions from bare and covered uranium mill tailings can be estimated from equations based on diffusion theory. Basic equations are presented for calculating surface radon fluxes from covered tailings, or alternately, the cover thicknesses required to satisfy a given radon flux criterion. Also described is a computer code, RAECOM, for calculating cover thicknesses and surface fluxes. Methods are also described for measuring diffusion coefficients for radon, or for estimating them from empirical correlations. Since long-term soil moisture content is a critical parameter in determining the value of the diffusion coefficient, methods are given for estimating the long-term moisture contents of soils. The effects of cover defects or advection are also discussed and guidelines are given for determining if they are significant. For most practical cases, advection and cover defect effects on radon flux can be neglected. Several examples are given to demonstrate cover design calculations, and an extensive list of references is included. 63 references, 18 figures, 6 tables.

25512 **(NUREG/CR—3697) Laboratory testing of chemical stabilizers for control of fugitive dust emissions from uranium mill tailings.** Elmore, M.R.; Hartley, J.N. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 48p. (PNL—5025). NTIS, PC A03/MF A01 - GPO $4.25; GPO Dep. Order Number DE84011210.

Pacific Northwest Laboratory is investigating techniques to control fugitive dust emissions from active uranium mill tailings piles. This report describes laboratory tests conducted to evaluate 45 commercially available chemical stabilizers. Tests were conducted in a wind tunnel to evaluate the effectiveness and durability of the stabilizers under similar conditions. The effects of application rate, temperature (freeze/thaw) cycling, wet/dry cycling, and wind speed were determined. In addition, tests were conduted to determine the effects of ultraviolet light and water erosion on the durability of the stabilizers. Permeability tests were also conducted to determine the potential effect of each stabilizer on the overall stability of the tailings pile. Results of these laboratory tests indicated that 16 of the stabilizers were equally effective and more durable than the others. 2 references, 9 figures, 14 tables.

25513 **(NUREG/CR—3758) Crosshole geophysical methods used to investigate the near vicinity of high level waste repositories.** Ramirez, A.L.; Lytle, R.J.; Harben, P. (Lawrence Livermore National Lab., CA (USA)). Jul 1983. Contract W-7405-ENG-48. 72p. (UCID—20060). NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. Order Number DE84011310.

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An evaluation is given of remote-probing geophysical techniques likely to be used to investigate the near vicinity of geologic repositories for nuclear waste. The sensors to be used would be placed inside the boreholes, shafts, and tunnels of the repository to provide high resolution information of the rock near the repository. The geophysical methods evaluated are known as active methods

because they make use of artificial seismic, electric, or electromagnetic fields to probe the rock mass. Techniques involving through transmission measurements are emphasized. These techniques show merit for remote detection of geological heterogeneities such as fracture zones which influence the containment capacity of repository sites. The report discusses the results obtained with exploration methods used at a site near Oracle, Arizona. 22 references, 16 figures.

25514 **(NUREG/CR—3774-Vol.1) Alternative methods for dispoal of low-level radioactive wastes. Task 1. Description of methods and assessment of criteria.** Bennett, R.D.; Miller, W.O.; Warriner, J.B.; Malone, P.G.; McAneny, C.C. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Geotechnical Lab.). Apr 1984. 85p. NTIS, PC A05/MF A01 - GPO* $4.50. Order Number DE84901100.

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The study reported herein contains the results of Task 1 of a four-task study entitled Criteria for Evaluating Engineered Facilities. The overall objective of this study is to ensure that the criteria needed to evaluate five alternative low-level radioactive waste (LLW) disposal methods are available to the Nuclear Regulatory Commission (NRC) and the Agreement States. The alternative methods considered are belowground vaults, aboveground vaults, earth mounded concrete bunkers, mined cavities, and augered holes. Each of these alternatives is either being used by other countries for low-level radioactive waste (LLW) disposal or is being considered by other countries or US agencies. In this report the performance requirements are listed, each alternative is described, the experience gained with its use is discussed, and the performance capabilities of each method are addressed. Next, the existing 10 CFR Part 61 Subpart D criteria with respect to paragraphs 61.50 through 61.53, pertaining to site suitability, design, operations and closure, and monitoring are assessed for applicability to evaluation of each alternative. Preliminary conclusions and recommendations are offered on each method's suitability as an LLW disposal alternative, the applicability of the criteria, and the need for supplemental or modified criteria.

25515 **(ORNL/Sub—82/13810/1) Experience and related research and development in applying corrective measures at the major low-level radioactive waste disposal sites.** Rose, R.R.; Mahathy, J.M.; Epler, J.S.; Boing, L.E.; Jacobs, D.G. (Evaluation Research Corp., Oak Ridge, TN (USA)). Jul 1983. Contract AC05-84OR21400. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010943.

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A review was conducted of experience in responding to problems encountered in shallow land burial of low-level radioactive waste and in research and development related to these problems. The operating histories of eleven major disposal facilities were examined. Based on the review, it was apparent that the most effective corrective measures administered were those developed from an understanding of the site conditions which caused the problems. Accordingly, the information in this document has been organized around the major conditions which have caused problems at existing sites. These include: (1) unstable trench cover, (2) permeable trench cover, (3) subsidence, (4) ground water entering trenches, (5) intrusion by deep-rooted plants, (6) intrusion by burrowing animals, and (7) chemical and physical conditions in trench. Because the burial sites are located in regions that differ in climatologic, geologic, hydrologic, and biologic characteristics, there is variation in the severity of problems among the sites and in the nature of information concerning corrective efforts. Conditions associated with water-related problems have received a great deal of attention. For these, corrective measures have ranged from the creation of diversion systems for reducing the contact of surface water with the trench cover to the installation of seals designed to prevent infiltration from reaching the buried waste. On the other hand, corrective measures for conditions of subsidence or of intrusion by burrowing animals have had limited application and are currently under evaluation or are subjects of research and development activities. 50 references, 20 figures, 10 tables.

25516 **(ORNL/TM—9156) Role of trench caps in the shallow land burial of low-level wastes.** Mezga, L.J. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011824.

Experience dating back to the early 1940s clearly documents the importance of isolating waste disposed of by shallow land burial from the biosphere. While no significant threat to the health and safety of the public has occurred to date, poor facility siting and/or design has resulted in a number of sites failing to perform as predicted or in an acceptable manner. The trench cap may be the single most important component of the LLW disposal system. It must effectively isolate the waste from the biosphere by controlling infiltration, gaseous emissions, and biointrusions. At the same time, a number of other forces (i.e., erosion and subsidence) are acting to destroy its integrity. Results of experiments and operational experience to date indicate that while one design feature may be effective at controlling one problem (e.g., cobble-gravel effectively controls biointrusion), that same design feature may be ineffective or actually exacerbate another problem (e.g., cobble-gravel may allow increased infiltration rates). Therefore, trench cap design must evaluate the systems effects of the various options either using intuitive methods as is currently the case or by using mathematical models which are currently being developed and validated. 36 references.

25517 **(PNL-SA—11573) Relationship between reaction layer thickness and leach rate for nuclear waste glasses.** Chick, L.A.; Pederson, L.R. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 10p. (CONF-831174—85). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010776.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

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Three leaching tests, devised to distinguish among several proposed nuclear waste glass leaching mechanisms, were carried out for four different waste glasses. In the first test, the influence of a pre-formed reaction layer on elemental release was evaluated. In the second test, glass specimens were replaced with fresh samples halfway through the leaching experiment, to evaluate the influence of the concentration of glass components in leaching. Finally, regular replacement of the leachant at fixed time intervals essentially removed the variable changing solution concentration, and allowed an assessment of the influence of reaction layer thickness on the leaching rate. Results for all glasses tested indicated that the reaction layer presented little or no barrier to leaching, and that most of the retardation on leaching rates generally observed are attributable to saturation effects. 20 references, 6 figures, 1 table.

25518 **(PNL-SA—11684) Predicting long-term moisture in earthen covers.** Gee, G.W.; Nielson, K.K.; Rogers, V.C. (Pacific Northwest Lab., Richland, WA (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Nov 1983. Contract AC06-76RL01830. 7p. (CONF-840245—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010699.

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Fort Collins, CO, USA (1 Feb 1984).

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Earthen cover systems will be used to control radon flux levels at most, if not all, uranium mill tailings disposal sites in the USA. The long-term residual moisture in an earthen cover will determine, to a large degree, the effectiveness of the cover for radon control. The cover moisture content is a function of climate, plant cover, soil type and depth to water table. Estimates of long-term moisture content can be made several ways. Simulations, using deterministic water flow models, provide the most complete description, but require the most detailed information, including long-term climate and plant cover changes, which at present have a high degree of uncertainty. Simpler correlations, related to soil type and expected periodic drought conditions, will likely be more practical for estimating long-term saturation to water retention characteristics of the soil and assumes that residual moisture in the entire soil cover will approach the so called permanent wilting point (15 bar percentage). The expected residual moisture saturation at perma-

nent wilting, ranges from 0.07 to 0.56 as soil texture varies from sands to clays at typical field densities. Radon diffusion coefficients for soil cover materials range from 5.0E-2 cm^2/s to 5.0E-3 cm^2/s for sands and clays, respectively, at typical field densities. With increased compaction, the residual moisture saturation can increase significantly and radon diffusion coefficients as low as 3.0E-4 cm^2/s have been measured. The optimal soil cover design will likely be a two-layer cover system with at least a 1-meter thick plant root zone of uncompacted soil over a moistened, tightly compacted fine textured soil. This design concept has been tested successfully at Grand Junction, Colorado. 11 references, 4 figures, 2 tables.

25519 **(PNL-SA—11821) Long-term stabilization of uranium mill tailings: effects of rock material on vegetation on soil moisture.** Beedlow, P.A.; Carlile, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1982. Contract AC06-76RL01830. 23p. (CONF-840245—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010844.

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Fort Collins, CO, USA (1 Feb 1984).

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A field-scale experiment was conducted to investigate the effects of pit-run rock and washed cobble on vegetation and soil moisture. The success of various seed mixtures, transplanting and irrigation levels were evaluated. Total cover changed negligibly from the first growing season to the next, but the structure of the vegetation changed markedly. Moderate levels of irrigation increased the establishment of perennial grasses and shrubs. Rock placed on the surface prior to planting resulted in increased cover of weeds, shrubs and forbs and decreased grass cover relative to soil without surface rock. The most successful seed mixture was one of predominantly shrub and forb species adapted to the local environment. No significant differences in soil moisture were found between surface cover types. 6 references, 7 figures.

25520 **(RFP—3619) Waste generation reduction: nitrates FY 1983 status report.** Meile, L.J.; Johnson, A.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 16 Feb 1984. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011325.

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A study was initiated at Rocky Flats Plant to develop and demonstrate technology to eliminate nitrates in low-level waste streams without the generation of objectionable oxides of nitrogen. A survey of nitrate waste inventories in the Department of Energy and commercial facilities indicated in excess of 1.2×10^8 kg of stored nitrate waste in 1981. Laboratory-scale evaluation of denitrification procedures was begun in 1982. Urea was found to be inefficient in destroying simulated nitrate wastes. Two thermal processes were evaluated and both produced denitrification efficiencies >95%. Evaluation of chemical methods of denitrification of aqueous nitrate wastes was continued during 1983. Significant progress was achieved through the use of chemical reaction promotion agents and catalysts. Although no chemical method achieved results equal to those produced by the thermal processes, denitrification efficiencies ranging from 65 to 85% were recorded during the aqueous tests. A thermodynamics study conducted to evaluate the feasibility of chemical denitrification indicated that favorable potentials exist for chemical denitrification reactions to proceed to completion. Failure to achieve complete reactions appears to be a kinetics problem. Microwave and ultrasonic stimulation were briefly tested as means to improve reaction kinetics. The results were inconclusive because of the preliminary nature of the tests. A peer review was conducted to obtain input on the progress and direction of the program from actual producers of nitrate waste. Six DOE facilities were contacted, and all responded with relevant comments and suggestions. The consensus appeared to favor a chemical denitrification method over a high-temperature thermal process if such were feasible. Concurrent development of both methods was suggested.

25521 **(SAND—83-2342C) Analysis of borehole inclusion stress measurement concepts proposed for use in the Waste Isolation Pilot Plant (WIPP).** Morgan, H.S. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 8p. (CONF-840633—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008025.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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The calculations presented in this paper were performed as part of an investigation of inclusion stressmeter performance in salt. They focus on the strain gaged stressmeter (SGS) and on a hypothetical solid cylindrical inclusion with variable stiffness. issues addressed include the effects of creep and the effects of gage stiffness on stressmeter output for various loading conditions. The computational procedures used to calculate gage response are described first and are followed by a presentation of the computed responses of the inclusions to several loading conditions. The results presented clearly indicate the problems involved in relating inclusion stressmeter readings to actual stress fields in salt. Readings change with time due to creep, and the nature of the changes is related to gage stiffness. Creep seems to affect matching inclusion response the least and soft inclusion response the most. In fact, the soft inclusion fails to distinguish small sudden changes in applied load and changes due to creep. The calculations also indicate that inclusion stressmeter performance in salt needs to be evaluated in even greater detail before stress measurements can be used for verifying computational models. The gage installation process needs to be included in this analysis. Field evaluations of several inclusion stressmeters are currently underway to meet these needs. 8 references, 8 figures, 2 tables.

25522 **(UCRL—88933) Application of proving-ring technology to measure thermally induced displacements in large boreholes in rock.** Patrick, W.C.; Reactor, N.L.; Butkovich, T.R. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 10p. (CONF-8406101—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010688.

From 5. international congress on experimental mechanics; Montreal, Quebec, Canada (10 Jun 1984).

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A strain-gauged proving-ring transducer was designed and deployed to measure small diametral displacements in 0.61-m diameter boreholes in rock. The rock surrounding the boreholes was previously heated by storage of spent nuclear fuel assemblies and measurements during post-retrieval cooling of the rock were made. To accomplish this, a transducer was designed to measure displacements in the range of 10 to 100 μm, to function in a time-varying temperature regime of 30° to 60°C at a relative humidity of 100%, to be of low stiffness, and to be easily and quickly installed. 7 references, 6 figures, 1 table.

25523 **(USGS-OFR—84-114) Stratigraphic and volcanotectonic relations of Crater Flat Tuff and some older volcanic units, Nye County, Nevada.** Carr, W.J.; Byers, F.M. Jr.; Orkild, P.P. (Geological Survey, Menlo Park, CA (USA)). 1984. Contract AI08-78ET44802. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010926.

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The Crater Flat Tuff is herein revised to include a newly recognized lowest unit, the Tram Member, exposed at scattered localities in the southwest Nevada Test Site region, and in several drill holes in the Yucca Mountain area. In previous work, the Tram Member was thought to be the Bullfrog Member, and therefore was shown as Bullfrog or as undifferentiated Crater Flat Tuff on published maps. The revised Crater Flat Tuff is stratigraphically below the Topopah Spring Member of the Paintbrush Tuff and above the Grouse Canyon Member of the Belted Range Tuff, and is approximately 13.6 m.y. old. Drill holes on Yucca Mountain and near Fortymile Wash penetrate all three members of the Crater Flat as well as an underlying quartz-poor unit, which is herein defined as the Lithic Ridge Tuff from exposures on Lithic Ridge near the head of Topopah Wash. In outcrops between Calico Hills and Yucca Flat, the Lithic Ridge Tuff overlies a Bullfrog-like unit of

reverse magnetic polarity that probably correlates with a widespread unit around and under Yucca Flat, referred to previously as Crater Flat Tuff. This unit is here informally designated as the tuff of Yucca Flat. Although older, it may be genetically related to the Crater Flat Tuff. Although the rocks are poorly exposed, geophysical and geologic evidence to date suggests that (1) the source of the Crater Flat Tuff is a caldera complex in the Crater Flat area between Yucca Mountain and Bare Mountain, and (2) there are at least two cauldrons within this complex - one probably associated with eruption of the Tram, the other with the Bullfrog and Prow Pass Members. The complex is named the Crater Flat-Prospector Pass caldera complex. 24 references, 18 figures, 1 table.

25524 **(WTSD-TME—011) Monitored retrievable storage conceptual system study: open field drywells.** Unterzuber, R.; Cross, T.E.; Krasicki, B.R.; Lundberg, W.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Waste Technology Services Div.). Aug 1983. Contract AC06-76RL01830. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010841.

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The purpose of this study is to assemble descriptions of open field drywell storage concepts from available literature and to then modify them as necessary to present a monitored retrievable storage (MRS) concept for spent fuel or high-level waste storage which satisfies a common set of requirements and assumptions provided by Pacific Northwest Laboratory (PNL). The MRS concept described herein will be considered by PNL against other similarly normalized concepts, will be evaluated for performance against a set of ranking criteria, and will then be considered by DOE for selection as the concept(s) to be developed for the MRS proposal to Congress due in mid-1985. A description of the open field drywell storage facility concept is presented with the operations required to handle the spent fuel or high-level wastes and transuranic wastes. A generic Receiving and Handling Facility, provided by PNL, has been used for this study. Modifications to the storage delivery side of the handling facility, necessary to couple the Receiving and Handling Facility with the storage facility, are described. The equipment and support facilities needed for the storage facility are also described. Two separate storage facilities are presented herein: one for all spent fuel storage, and one for storage of high-level waste (HLW) and transuranic waste (TRU). Each facility is described for the capacities and rates defined by PNL in the Concept Technical Performance Criteria and Base Assumptions. Estimates of costs and time-distributions of expenditures have been developed to construct, operate, and decommission the conceptual MRS facilities in mid 1983 dollars, for the base cases given using the cost categories and percentages provided by PNL. 3 references, 17 figures, 16 tables.

25525 **(WTSD-TME—013) Monitored Retrievable Storage conceptual system study: transportable storage casks.** Unterzuber, R.; Cross, T.E.; Krasicki, B.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Waste Technology Services Div.). Aug 1983. Contract AC06-76RL01830. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010684.

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Conceptual designs of three Monitored Retrievable Storage (MRS) cask storage facilities have been prepared along with an estimate of life cycle costs for each. The designs are for two all spent fuel storage facilities and one high-level waste and transuranic waste facility with capacities of 15,000 equivalent metric tons of uranium (MTU) and 72,000 equivalent MTU. These designs were developed using criteria and assumptions provided by PNL. Each storage facility consists of a generic Receiving and Handling Facility (designed by Kaiser Engineers) with modifications for storage cask handling (and unloading damaged casks), on-site handling and transportation equipment (low-bed trailer and tractor, and mobile crane), a storage facility consisting of an array of concrete storage pads, and the support facilities and equipment (security, utilities, etc.) needed to maintain facility operations. The high-level waste and transuranic waste storage facility includes a prefabricated concrete storage building for the contact-handled transuranic waste received. Detailed cost estimates have been developed for these facilities which include costs for construction, operation and decommissioning for the 15,000 MTU capacity facility. Total costs and present worth costs in mid-1983 dollars for these facilities have been estimated. In addition, costs have been developed for the incremental expansion of these facilities to a 72,000 MTU storage capacity. 3 references, 17 figures, 4 tables.

25526 **Low-level radioactive waste regional compacts. Hearing before the Subcommittee on Energy Conservation and Power, of the House of Representatives, Ninety-Eighth Congress, first session on H.R. 1012, H.R. 3002, and H.R. 3777, 3 Nov 1983.** Washington, DC; US Government Printing Office (1984). 321p.

Representatives of several states, several regional low-level waste offices, health services, and others testified at a review of the progress made since passage of the 1980 Low-Level Radioactive Waste Policy Act made the safety and efficient management of these wastes a regional concern. Four of the six regional authorities have submitted compact proposals to Congress. The witnesses were asked to discuss how low-level wastes will be managed in states which have not agreed to regional facilities, and whether their wastes will be acceptable elsewhere. The texts of H.R. 1012, H.R. 3002, and H.R. 3777, which grant Congressional consent to Northwest, Central, and Southeast compacts are followed by the testimony of 16 witnesses and additional material submitted for the record.

25527 **Improved method for extracting lanthanides and actinides from acid solutions.** Horwitz, E.P.; Kalina, D.G.; Kaplan, L.; Mason, G.W. (to Dept. of Energy). US Patent Application 6-517,475. 26 Jul 1983. 22p. Contract W-31-109-ENG-38.

A process for the recovery of actinide and lanthanide values from aqueous acidic solutions uses a new series of neutral bi-functional extractants, the alkyl(phenyl)-N,N-dialkylcarbamoylmethylphosphine oxides. The process is suitable for the separation of actinide and lanthanide values from fission product values found together in high-level nuclear reprocessing waste solutions.

25528 **Immobilization of radioactive cesium in pyrolytic-carbon-coated zeolite.** Stinton, D.P.; Lackey, W.J.; Angelini, P. (Oak Ridge National Lab., TN). *Journal of the American Ceramic Society;* **66**: No. 6, 389-392(Jun 1983). Contract W-7405-ENG-26.

All waste forms currently being developed for radwaste disposal have difficulty immobilizing cesium. A new waste form was developed to dispose of cesium by loading up to 5 wt% Cs onto zeolite granules. These zeolite particles are then heat-treated and coated with pyrolytic carbon and/or SiC to completely immobilize cesium. The leach rate of cesium from pyrocarbon-coated zeolite is 3 to 4 orders of magnitude less than for other waste forms. The authors propose that cesium be removed from the primary waste stream and loaded onto zeolite granules for subsequent coating. The total waste form (primary waste form plus coated zeolite) would have acceptable leach resistance for all radwaste components and be extremely leach-resistant for cesium. 23 references, 4 figures, 2 tables.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 25481, 25482, 25489, 25515, 25517, 27063

25529 **(OSS/TM—1) Transport of trace metals in the Magela Creek system, Northern Territory. I. Concentrations and loads of iron, manganese, cadmium, copper, lead and zinc during flood periods in the 1978-1979 wet season.** Hart, B.T.; Davies, S.H.R.; Thomas, P.A. (Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia)). Dec 1981. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700933.

In order that realistic effluent standards may be established for the Ranger uranium operations at Jabiru, Northern Territory, it is necessary that there be a clear and detailed knowledge of the pre-mining levels of trace metals and their behaviour within the Magela Creek system. During the wet season, floodwaters were

sampled for conductivity, suspended solids and the trace metals, iron, manganese, cadmium, copper, lead and zinc. All concentrations were found to be very low, as were the denudation rates for the trace metals and suspended materials.

25530 **(OSS/TM—2) Transport of trace metals in the Magela Creek system, Northern Territory. II. Trace metal concentrations in the Magela Creek billabongs at the end of the 1978 dry season.** Davies, S.H.R.; Hart, B.T. (Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia)). Dec 1981. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700934.

Billabongs downstream of the Ranger uranium mining operation have been identified as potential deposition areas for released trace metals. Samples were taken at the end of the dry season and analysed for total and filterable concentrations of Fe, Mn, Cd, Cu and Zn. There was an increase in the concentrations of total Fe, Zn, Cd and Cu in the backflow and flood plain billabongs compared with the concentrations recorded during the wet season. The increase was most noticeable for iron.

25531 **(OSS/TM—3) Transport of trace metals in the Magela Creek system, Northern Territory. III. Billabong sediments.** Thomas, P.A.; Davies, S.H.R.; Hart, B.T. (Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia)). Dec 1981. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700935.

Since it has been reported that a number of the billabongs downstream of the Ranger uranium deposits appear to accumulate suspended material transported by Magela Creek, monitoring of the trace metal levels in such billabongs should provide a convenient means for determining whether changes have occurrred as a result of the mining operations. Preliminary analysis of sediments collected from the billabongs has indicated widespread variations in sediment types and trace metal concentrations. The poor reproducibility found for trace metal levels was largely overcome by analysis of the <20 μm fraction.

25532 **(PNL-SA—11388) Mapping subsurface radionuclide migration and groundwater flow with organic tracers.** Toste, A.P.; Kirby, L.J.; Pahl, T.R.; Myers, R.B. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 4p. (CONF-8310157—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010627.

From 29. annual conference on bioassay, analytical and environmental chemistry; Seattle, WA, USA (12 Oct 1983).

At Pacific Northwest Laboratory we have had the opportunity to study the subsurface migration of radionuclides at the Maxey Flats burial site. We constructed an experimental study area adjacent to one of the waste-filled trenches at the site. In this report we describe some preliminary results of organic research currently underway at Maxey Flats. This research is aimed at: (1) elucidating the role of organic species in the subsurface migration of radionuclides; and (2) testing the usefulness of artificial and in situ organic groundwater tracers for mapping radionuclide migration and groundwater flow. We also describe two analytical procedures developed for this research. First, as part of a survey study of organics in Maxey Flats groundwater we have developed a procedure for the isolation and characterization of trace levels of organics in radioactive groundwaters. Second, for a detailed chemical speciation study we developed a procedure based on steric exclusion chromatography for testing whether or not organics are chelated to radionuclides. 1 figure, 1 table.

25533 **(PNL-SA—11643) Neutralizing barrier for reducing contaminant migration from a uranium mill tailings disposal pond.** Opitz, B.E.; Sherwood, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1983. Contract AC06-76RL01830. 11p. (CONF-840245—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011270.

From 6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste; Fort Collins, CO, USA (1 Feb 1984).

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Under sponsorship of the Nuclear Regulatory Commission's Uranium Research and Recovery Program, Pacific Northwest Laboratory, (PNL) has investigated the use of various neutralizing reagents and techniques to attenuate the movement of contaminants associated with acidic uranium mill tailings solutions. Results of these investigations have led to the development of a low permeable, neutralizing barrier that may effectively reduce contaminant migration from a tailings impoundment. In terms of contaminating surface or ground water, the waste solution of primary concern is that which escapes the designated waste disposal facility. By incorporating a neutralizing barrier below the tailings pond, the only solution that is treated is that which escapes. Therefore, substantial solution treatment cost savings could result from not having to treat the entire solution within a tailings pond in order to minimize the effects of drainage of acidic uranium mill tailings solution. In laboratory verification tests, a neutralizing barrier reduced the effluent solution concentrations of several constitutents (e.g. Al, As, Cr, Fe, V, ^{210}Pb, ^{238}U and ^{230}Th) by greater than 90% in comparison to concentrations found within the pond. Furthermore, the neutralizing barrier inhibited drainage because of its reduced permeability (10^{-8} cm/s). 9 references, 3 figures, 4 tables.

0540 Health And Safety

REFER ALSO TO CITATION(S) 25398, 25405, 25412, 25413, 25414, 25428, 25430, 25438, 25443, 25444, 25445, 25446, 25447, 25469, 26572, 26600, 27166, 27179, 27233

25534 (CONF-830528—Vol.1, pp 173-183) **Evaluation of doses to workers and general public from the carriage of radiopharmaceuticals: an application of the INTERTRAN code.** De Marco, I.; Mancioppi, S.; Piermattei, S.; Scarpa, G. (ENEA, Rome, Italy). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The aim of this paper is the evaluation of individual and collective doses to transport workers and general public from the shipments of radioactive materials in Italy. The data concerning the shipments by road of radioisotopes for medical uses in the years 1981-1982 were collected and the standard shipment lists were compiled. In the standard shipment list the number of packages of each radioisotope, the average transport index and the average mileage per shipment are collected. We wish to underline that there is no substantial increase in the number of packages transported per year, and the percentage of packages among the three categories is around 50% White I, 30% Yellow II, 20% Yellow III. A statistical sampling was also carried out on packages; it appeared that for packages of Yellow III category the average radiation level at surface was 100 mrem/h at the 0.7 TI; while Yellow II category packages showed a radiation level of 30 mrem/h at the surface and 0.2 TI.

25535 (CONF-830528—Vol.1, pp 192-199) **Optimization of radiation protection in the transportation of radioisotopes.** Palacios, E.; Menossi, C.A. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The collective effective dose equivalent incurred by the population in Argentina as a result of the distribution of radioisotopes for medical applications is estimated. An analysis is performed on the optimization of radiation protection in the transportation of radioisotopes, following the recommendations of the International Commission on Radiological Protection (ICRP). In Argentina, radiopharmaceutical products are arranged and distributed in type-A packages under the regulations for the safe transport of radioactive materials of the International Atomic Energy Agency (IAEA). Additionally, the national regulatory authority requires the application of the dose limitation system to all practices involving radiation exposure by man. Radioisotopes are transported in special vehicles (60%), in domestic flights (30%) and in buses (10%). The collective effective dose equivalent was estimated by taking into account the different transportation means and the storage time while radioisotopes are in transit. The differential cost-benefit analysis shows that,

in order to obtain an optimized level of protection, it would be necessary to reduce the current dose rates during transportation. This is particularly worthwhile when the distribution is made through public transportation, such as commercial planes or buses. It is concluded that, for the application of the dose limitation system to the transport of radioisotopes, it would be necessary to reduce the present IAEA limits of radiation levels at a one-meter distance from the packages in about a factor of ten. 6 references, 3 tables.

25536 (CONF-830528—Vol.1, pp 311-316) **Cost-effectiveness of safety measures applying to uranium hexafluoride transportation in France.** Hubert, P. (Centre d'etude sur l'Evaluation de la Protection dans le domaine Nucleaire, Fontenay-Aux-Roses, France); Pages, P.; Auguin, B. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper addresses the problem of uranium hexafluoride transportation by truck and train. It consists of a probabilistic risk assessment of the potential hazards to the public that can arise from the traffice that will take place in France in 1990. The specificity of UF_6 is that it presents both chemical and radiological hazards. But, whatever the transported material, road traffic entails a risk of its own. Thus three kinds of risk are assessed for natural, depleted and enriched uranium hexafluoride. These assessments are the basis of a cost-effectiveness analysis which deals with such safety measures as using a protective overpack, avoiding populated area and escorting the trucks. The results presented here are based upon research supported by the C.E.A. (Commissariat a l'Energie Atomique). It is linked to a more general program of experiments and theoretical analyses on package safety and accidental releases for uranium hexafluoride. 7 references, 2 figures, 4 tables.

25537 (CONF-830528—Vol.1, pp 326-333) **Risk analysis of transporting vitrified high-level radioactive waste by train.** Schneider, K.A. (Transnuklear GmbH, Hanau, Germany); Merz, E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Reprocessing plants (RPPs) and final disposal sites for vitrified high level radioactive waste (HLW) will be at distant locations in the Federal Republic of Germany (FRG). HLW will also have to be shipped from RPPs located in foreign countries to a final disposal site in the FRG. Thus transportation of HLW on public routes will become necessary. A model of an HLW shipping system is presented which meets the needs of an established nuclear industry. Reference ages of the HLW were assumed to range between about 5 years and about 50 years. Thus HLW shipping systems covering this period are analyzed. The safety of nuclear installations is ensured by means of a design according to the design based accident. The same applies to shipping casks for radioactive materials (RAM) according to the IAEA Regulations. The aim of this work was to make as complete as reasonably possible an estimate of the risk of shipping HLW. The safety of the system was therefore analyzed by means of probabilistic risk assessment. Release of radioactive material due to transportation accidents is considered. 5 references, 5 figures, 6 tables.

25538 (CONF-830528—Vol.1, pp 334-342) **Nordic study on reactor waste.** Tveten, U. (Institute for Energy Technology, Kjeller, Norway). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The conclusions relevant to transportation were the following: the risk from a bitumen fire is not considered critical. It must be ensured, however, that the amount of radioactive materials contained in the release from one event can not be significantly larger than assumed. The doses may then reach a level where acute health effects may be encountered, and the basis for risk judgement is drastically changed if this is the case. A hundred times higher nuclide content would probably be considered unacceptable. However, the possible unrealistically high estimated fraction of nuclide content released during fire should be kept in mind. From a risk point of view sea transportation seems to be preferable. The analysis for sea transportation, however, was performed for one accident location only. Other possible accident locations might lead to significantly higher individual committed doses. Change of accident location in the land transportation case will not lead to significantly different doses. The doses resulting from a transportation accident will not increase much, even if the 5 years extra radioactive decay during temporary storage of the waste is not taken into account. Any requirements to mechanical strength of the waste products from a transportation point of view are not motivated. 13 references, 6 figures, 1 table.

25539 (CONF-830528—Vol.1, pp 343-349) **Transport analyses for determination of man-rem dose rates with regard to different modes of transport, routing and packaging.** Maass, K.E. (Hahn-Meitner-Institut fuer Kernforschung GmbH, Berlin, Germany); Weber, P.M.; Geipel, H.; Huebner, H.W.; Weymann, J. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Safety analysis of transports, boundary conditions for transport scenarios, and performance of the transport analysis are discussed. 4 references, 5 figures.

25540 (CONF-830528—Vol.1, pp 350-356) **Risk assessment for truck-transport assuming different concepts of the back-end of the fuel cycle.** Tully, A. (Dornier System, Friedrichshafen, Germany); Sonnenschein, R.; Haeusler, S. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The different concepts of the back-end of the fuel cycle existing in the Federal Republic of Germany require that various types of radioactive materials will be transported along different pathways, for various distances and at different frequencies, thus resulting in different risks to the public. In one part of the second phase of the R + D program Projekt Sicherheitsstudien Entsorgung (PSE), the risk during normal and accident conditions will be assessed for each of the concepts of the back-end of the fuel cycle. Within this part of the safety analysis, DORNIER SYSTEM will determine the risks resulting from the transport of radioactive materials by truck, using the probabilistic method of fault tree analysis. This part of the investigation will extend until the end of 1983. 4 references, 5 tables.

25541 (CONF-830528—Vol.1, pp 697-704) **Study of the exposures received by the persons involved in the transportation of radioactive materials.** Hamard, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France); Sousselier, Y. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

An important step in the optimization process applied to exposures in the field of the transport of radioactive materials is an accurate inventory of the exposures actually received by the workers. The results of this study underlines that nearly all the doses received are well below the threshold values for the classification of the workers as occasionally exposed and a fortiori as professionally exposed and consequently no personal monitoring should be necessary for them. Thus the inventory of exposures is somewhat difficult as the workers implied in the transport process are not classified as exposed workers and not subject to personnal or collective dosimetry. Therefore a good knowledge of the exposures received during the transport of irradiated fuels should require a systematic follow up of this kind of transport all along their route including a careful dosimetric monitoring of the workers taking part in the transport. On the other hand, the reduction of the doses obtained by increasing the mechanization involves very high monetary costs as compared to the reduction of the detriment. Perhaps a more important reduction of the exposures could be attained by a better protection in the cars or lorries used for the transport of categories A and B packages. But it seems that in the case of the transports, the optimization is applied mainly during the conception and the

testing of the packages and only little progress will be possible without involving disproportionated monetary costs. 4 references, 10 tables.

25542 (CONF-830528—Vol.1, pp 705-711) **Radiation exposure resulting from the transport of radioactive materials within the United Kingdom.** Shaw, K.B. (National Radiological Protection Board, Chilton, England); Mairs, J.H.; Gelder, R.; Hughes, J.S.; Holyoak, B. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The transport of technetium generators for hospital use accounts for some 50% of the occupational exposure from the normal transport of radioactive materials. Other isotopes for medical and industrial use contribute about 35% of the occupational exposure and some 15% can be attributed to transportation as a result of the nuclear fuel cycle including the transport of irradiated nuclear fuel. 5 references, 6 tables.

25543 (CONF-830528—Vol.1, pp 712-718) **Statistical data on the transport of radioactive materials in Italy and radiation dose evaluation to transport workers.** De Marco, I.; Faloci, C.; Mancioppi, S.; Orsini, A. (ENEA-DISP, Rome, Italy). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The availability of statistical data on the activity in the shipment of radioactive materials (RAM) is very useful both to evaluate the adequacy of the regulations set up at the international level and to assess the collective dose deriving from the transport either under normal or accident conditions. Because of this need for data, the IAEA requested that Member States collect statistical data on national and international transport of RAM. Collection of data will be completed by the end of 1983. 1 figure, 3 tables.

25544 (CONF-830528—Vol.1, pp 719-723) **Radiation exposure due to railway transport of radioactive materials.** Baran, A. (NUKEM GmbH, Hanau, Germany); Pollmann, E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The purpose of this work was the estimation of the collective doses of population groups in the vicinity of the transport routes within the Federal Republic of Germany due to incident-free transport. The study covers shipments of radioactive material (RAM) typical for the three main waste-management concepts: the nuclear reprocessing center (one site for all back-end facilities), the integrated back-end concept (separate sites for interim storage of spent fuel, reprocessing and waste disposal), and the alternative back-end concept (no reprocessing with direct disposal of spent fuel). The RAM to be transported are: spent light water reactor fuel, high-level waste, medium-level waste, low-level waste, mixed-oxide fuel powder, and liquid uranium nitrate.

25545 (CONF-830528—Vol.1, pp 732-736) **Comparison of transports expected under different waste management concepts: determination of basic data for application in risk analyses.** Alter, U. (Gesellschaft fuer Reaktorsicherheit (GRS), Koeln, Germany); Mielke, H.G.; Wehner, G. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

According to the Atomic Act, article 9a, paragraph 1, the licensees of nuclear power plants in the Federal Republic of Germany are obliged to provide for the management of radioactive wastes resulting from the operation of these plants. Concerning the provisions to be made for the management of such wastes, two concepts are discussed: nuclear reprocessing and final waste disposal center (Nukleares Entsorgungszentrum, NEZ); and the integrated spent fuel and waste management concept (Integriertes Entsorgungskonzept, IEK). Unlike the NEZ, the IEK-concept may have different sites for the following fuel cycle facilities: intermediate spent fuel storage, reprocessing, waste conditioning and final disposal, and uranium and plutonium fuel element fabrication facilities. The fundamental differences of the pertinent transports are presented. Transport scenarios expected under the two alternatives NEZ and IEK have been elaborated for the purpose of a data collection covering the following aspects: materials to be shipped, number of packages shipped, number of packages shipped per transport, transport by rail or by road, transport routes and distances, and duration of transports.

25546 (CONF-830528—Vol.1, pp 737-744) **Experimental determination of radionuclide release and transport from spent fuel exposed to cask fire environment.** Burian, R.J. (Battelle, Columbus Labs., OH); Kok, K.D.; Sandoval, R.P. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The objectives of this program include: to identify those conditions within a transportation cask which produce fuel cladding failure, and to determine by test the magnitude of the source term so produced. The first objective was achieved by an intensive search of the literature. The second was achieved by a test program designed to reproduce the environment existing within a cask due to realistic transportation accident conditions. The following conclusions can be made from the results of these tests: (1) both irradiated and unirradiated zircaloy cladding swell in a similar, ductile manner; (2) cladding failure is caused by bursting in the highly strained, swollen region; (3) the burst opening is very small and difficult to discern without magnification; (4) essentially all the release occurs during fuel pin depressurization within the first few seconds after cladding failure; (5) the amount of particulate material released from a fuel pin during cladding failure is relatively small and cannot be defined as catastrophic; (6) about 90 percent of the released particulates are readily removed from suspension by deposition on surfaces due either to gravity (loss of velocity) or by impingement; and (7) fuel pin failure would not be predicted for the hypothetical fire conditions specified in the NRC and IAEA Regulations.

25547 (CONF-830528—Vol.2, pp 849-854) **Emergency response planning guidelines for state and local governments for radioactive materials transportation accidents.** Carriker, A.W.; Wingert, V.L.; McClure, J.D. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper provides an overview of the document Guidance for Developing State and Local Radiological Emergency Response Plans and Preparedness for Transportation Accidents with respect to: document development; a description of general and background information contained in the document; an explanation of the planning basis assumed in the document; an explanation of the guidance presented in the form of planning objectives; and the next steps in developing integrated hazardous material planning and preparedness guidance. Within the areas identified above, this document is presented as non-regulatory guidance to be tailored to the varied needs and governmental structures of state and local jurisdictions in the United States.

25548 (CONF-830528—Vol.2, pp 855-856) **Radiological assistance plan.** Vetter, D.E. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV). Dec 1983. NTIS, PC A99/MF A01. Contract AC08-76NV00410.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The US Department of Energy's (DOE) Nevada Operations Office (NV) is ready 24 hours a day to provide radiological assistance in emergencies involving the transportation of radioactive materials in Nevada and neighboring states. The DOE's regional Radiological Assistance Team (RAT) and the supplemental DOE/NV radiological cleanup team are on call 365 days a year to respond to radiological accidents. About 25 years ago the DOE's predecessor,

the Atomic Energy Commission, established its areas of responsibility for radiological assistance. For Nevada, California, and Hawaii there are five RAT groups under the regional coordination at DOE's San Francisco Operation Office. By agreement with the regional office, and under a Memorandum of Understanding with the State of Nevada, the Las Vegas team responds when called to radiological materials accidents in Nevada and assists with cleanup as requested by proper state and local authorities.

25549 (CONF-830528—Vol.2, pp 857-861) **Model railroad industry nuclear emergency response plan.** Furber, C.P. (Association of American Railroads, Washington, DC); Brobst, W.A. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Some day, perhaps soon, there will be a serious rail accident involving nuclear materials, and there will be some significant damage to the nuclear containers. There may be some release of the radioactive contents. What then? How well will be railroads be prepared to handle the many problems that will arise when that bad accident happens? How will the railroads handle the cleanup problems? How will such an accident interfere with restoring railroad operations, different from what happens in other hazardous materials accidents? How will the railroads handle the public information aspects of a nuclear accident, a whole new ball game from what is involved in other hazardous materials accidents? Should the railroads hire their own nuclear experts? Should they train and equip radiological monitoring teams of their own? Do they even have a plan of how to deal with all of these matters? An approach is discussed for dealing with these problems and what the Association of American Railroads is doing to help solve them.

25550 (CONF-830528—Vol.2, pp 862-867) **Radiological response training for law enforcement personnel.** Maixner, R.D. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV). Dec 1983. NTIS, PC A99/MF A01. Contract AC08-76NV00410.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A specialized training course for Nevada's law enforcement personnel has been conducted by Reynolds Electrical and Engineering Co., Inc. for the US Department of Energy since February 1981. This course is designed for those persons who are first to arrive at a transportation accident scene. The course provides a basic understanding of radiation protection, the prevention of contamination spread from the accident site, use of radiation detection equipment, and decontamination procedures. The Department of Energy's Nevada Operations Office provides the training at no cost to Nevada agencies. Each agency selects its attendees. Details of the course are given.

25551 (CONF-830528—Vol.2, pp 868-870) **Things that can go wrong when time is of the essence.** Rymer, A.C. (Science Applications, Inc., Oak Ridge, TN); Taynton, L.F.; Blalock, L.G. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Emergency response capabilities have been improved immensely; however, efficiency can be improved. Emphasis on the need for continuing response planning by governmental agencies and the need for improved coordination between all levels of government is required. Identification of resources (both personnel and equipment) available in each agency and in each respective governmental level and the means of securing available resources is imperative to minimize the effects of transportation incidents and accidents. In an effort to alleviate some of these problems, the Department of Energy has developed a program to make its contractors more aware of information currently available to assist them and first responders. The two major aspects of this program are: training transportation information resource availability. Improved awareness of information or training materials currently available for first responders and improved understanding of lessons learned will hopefully have an impact on the nuclear industry's ability to provide better response in the future.

25552 (CONF-830528—Vol.2, pp 929-933) **Contamination studies on pond-loaded casks.** Bond, R.D.; Curren, W.D. (United Kingdom Atomic Energy Authority, Dorset, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The absorption of radiocesium from fuel ponds into paint films is followed by migration of cesium into the body of the paint if pond concentrations are high and immersion times are prolonged. Complete removal of contamination in finite time is therefore not feasible unless the paint itself is removed. A mechanism, supported by experimental results, is proposed. Problems can be minimized by implementing certain operational precautions, which are listed. Promising long-term solutions will depend on preventing absorption of cesium, perhaps by pre-treating the paint with non-active ions or by the use of barrier coatings.

25553 (CONF-830528—Vol.2, pp 934-940) **Fundamental studies of the ionic contamination of painted surfaces.** Gwyther, J.R. (Berkeley Nuclear Labs., England); Hancock, R.; Rodliffe, R.S.; Thornton, E.W.;; Haighton, A.P. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The exterior surfaces of spent nuclear fuel transport flasks used by the UK Central Electricity Generating Board (CEGB) are coated with a paint system: two primer coats [epoxy resin (Epikote 1001) + 15% $TiO_2/ZnCrO_4$] and two top coats [aliphatic polyurethane (DX32 + Desmodur N) + 15% TiO_2]. This has excellent resistance to mechanical damage, gross degradation by weathering (chalking etc.) and uptake of radioactivity. It was introduced some 12 years ago following a series of comparative trials and is called CEGB6. The transport flasks are immersed in some CEGB power station nuclear fuel cooling ponds during loading and there is consequently the prospect of external surface contamination of the CEGB6 paint. Flasks are decontaminated before dispatch from nuclear sites. The chemistry conditions and radiologically most significant isotopes found in the two types of fuel cooling pond used by the CEGB are summarized. This paper is concerned with the science of contamination and decontamination and concentrates on CEGB6 under Magnox pond chemistry conditions.

25554 **(K/CSD/TM—55) Radiation levels in a gaseous diffusion plant assuming a low-enriched criticality event corresponding to the ANSI-Standard minimum accident of concern.** Westfall, R.M.; Knight, J.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Feb 1984. Contract W-7405-ENG-26. 50p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009394.

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The two-dimensional DOT-IV discrete-ordinates program was applied in analyses of the K-33 cell floor radiation levels due to four hypothetical criticality events. The radiation sources correspond to leakage spectra from critical uranyl fluoride solutions ranging from 1.2 to 4.95 weight percent enrichment. For the criticality-alarm-system ANSI Standard 8.3 minimum accident of concern (1200 Rad/hour at 2 meters from the surface of the critical volume), the dose rates at the maximum source-detector distance vary from approximately 150 to 200 mRad/hour of either neutron or photon radiation. The report includes a discussion of the methodology employed in the study, biological dose rates, thermal neutron reaction rates and appended dose rate plots.

25555 (LA—9911-C-Vol.1, pp 1-19) **General considerations on fire and explosions in a nuclear facility interaction with ventilation.** Savornin, J. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

French regulations applicable to fire and explosion prevention in nuclear facilities are briefly surveyed. A number of fires in French facilities are discussed. Experiments underway which will

provide data needed for safety analysis and definition of preventive measures are described.

25556 (LA—9911-C-Vol.1, pp 21-29) **Regulations for fire and explosion prevention in nuclear facilities. Volume I and current assessment of fire impact in a reprocessing plant upon the environment in Japan.** Kitani, Susumu; Kawasaki, Masahiro. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The regulations for design and construction of facilities to prevent fire and explosion are provided, not only by the law for nuclear facilities, but also by laws for industry in general. The guidelines for fire and explosion prevention are established for light water reactor and other nuclear fuel cycle facilities as parts of the guidelines for nuclear safety examination by the Nuclear Safety Commission of Japan. In the safety analysis of a reprocessing plant, postulated accidents, including fire and explosion are examined. The impact upon the environment due to an accident are evaluated by the release of radioactivities from a solvent fire in an extraction cell.

25557 (LA—9911-C-Vol.1, pp 57-79) **Fire source simulation.** Krause, F.R. (Los Alamos National Lab., NM). Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Forced-ventilation fire scenarios are defined numerically by specifying the number and location of fuel packages in the room, the burn area and fire type for each fuel package, and the initial volumetric exhaust flux. The analyst may choose from 12 different fire types. The Los Alamos fire source analysis program then predicts fire growth using three source terms that give the rate of fuel injection, the rate of heat deposition in the exhaust gas, and the exhaust flux or particulate matter. Source-term time histories indicate an early fuel-controlled fire stage and a second compartment-controlled stage of the fire. One important performance criterion for fire source simulation is the stability of predictions over a wide range of fire scenarios. Source term stability is achieved by using a simple analytical solution of the mass balance equation. The stability of airflow network analysis codes is improved greatly by imposing bounding factors on source terms, which prevent physically unrealistic input specifications. Preliminary experimental verifiation of source terms and bounding factors has shown that the method may be applicable to fire scenarios other than those tested.

25558 (LA—9911-C-Vol.1, pp 109-117) **Characterization of radioactive aerosols from fires.** Buijs, K.; Chavance de Dalmassy, B.; Schmidt, H.E. (Commission of the European Communities, Karlsruhe, Germany). Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

A research project aimed at the charaterization of radioactive aerosols generated by a fire in a plutonium fuel production facility or a plutonium laboratory is investigating: (1) the diameters of particles which carry airborne alpha activity; (2) the distances over which the activity may be carried; and (3) the radiological risk associated with the smoke. The project comprises a study of full-scale laboratory fires with oxide powders simulating plutonium. A fire chamber, 35 m^2 floor area, 4.90 m high, has been equipped with devices for fire monitoring and aerosol sampling. After exploratory experiments to define limiting conditions for air supply, flame temperature, smoke concentration, metal content, and aerosol sampling times, fire tests wre performed with glove box components, doped with a mixture of cerium and europium oxide. The experimental facilities and first results of the experiments are described.

25559 (LA—9911-C-Vol.1, pp 119-135) **Use of deterministic computer codes to assess fire behavior and ventilation requirements in confined enclosures: present capabilities and future prospects.** Galant, S. (Societe Bertin & Cie, Plaisir, France). Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The present paper aims at reviewing four areas where BERTIN's own experience together with actual French research and development programs tend to dwell upon in order to systematize the engineering use of numerical fire and ventilation computer software packages (FVSP). These areas are: (1) the development of coherent combustion mathematical models which consider interactions of a wide variety of potential combustible materials and the prediction of combustion rates (as a function of ventilation rates), of soot production rates and of radiation heat transfer rates; (2) the insertion of such models in adequate software packages, which can be termed phenomenological, field or zone models depending upon the spatial scales of interest for the modeller; (3) the parallel development of coherent experimental programs to qualify the extensive use of computer models: emphasis is put on the need for adequate flow field characteristics (average and fluctuating values for temperature, velocities, concentrations, radiative fluxes); and (4) the development of industrial computer codes which cqn be used by engineers who might not be in close contact with the original code designer. These four basic points are illustrated through recent results obtained by BERTIN in nuclear or non nuclear safey research programs. Emphasis is put on present achievements, needs for complementary programs and future prospects of FVSP when dealing with engineering calculations.

25560 (LA—9911-C-Vol.1, pp 137-151) **Analysis of fire and explosion accidents in a fuel reprocessing plant.** Hoermann, E. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Under contract to the Germany Ministry of Research and Technology since 1977 Dornier System is investigating major accidents in a fuel reprocessing plant, such as solvent fire, zircaloy cladding fire, red oil explosion, and criticality. The physical, chemical and technical conditions governing these accidents are modelled. The probability of accidents is determined by the fault tree method. A computer model to describe a solvent fire within a process cell is presented. Results are given for the solvent fire in the 3rd Pu-Cycle.

25561 (LA—9911-C-Vol.1, pp 153-167) **Safety evaluation of ventilation networks in case of fire.** Perdriau, P.; Pourprix, M.; Raboin, S.; Rouyer, J.L.; Tarrago, X. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Several teams from CEA have cooperated to produce a code for modeling ventilation networks under accidental conditions in nuclear facilities. The objective is to study responses to a network to perturbations which are either mechanical or thermal. Such a tool was necessary for safety and protection studies because ventilation network performances are difficult to evaluate when the network gets complex. There was no requirement for a very sophisticated code, considering the margin of error which generally characterizes the ventilation measurements, but this code should be well validated to become a reliable tool for pointing out safety problems at the design stage and during the operating life of the ventilation system. The code has been called PIAF. It solves a set of equations which simulate a ventilation network in a permanent regime.

25562 (LA—9911-C-Vol.1, pp 169-181) **Calculating the consequences of a kerosene pool fire: the FLAMME computer code.** Malet, J.C.; Duverger de Cuy, G. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

FLAMME is a computer program designed to calculate the thermodynamic consequences of a kerosene fire in a ventilated or unventilated room. It is a multizone model that describes the exchanges of energy due to thermal radiation and the exchanges of matter due to pyrolysis, to air entrainment by the hot plume, and to the ventilation system.

25563 (LA—9911-C-Vol.1, pp 183-197) **Numerical simulation of thermodynamical characteristics evolution in an air handling system equipped laboratory in case of accidental fire.** Bodart, X.E.; Curtat, M.; Hognon, B.; Rouyer, J.L. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Results of numerical simulations of the evolution of thermodynamical characteristics in an air handling system equipped laboratory in case of accidental fire are presented. They have been computed using a C.S.T.B. fire compartment model, and compared with results of experiments concerning a solvent pool fire in a 400 m^3 cell and a glove-box fire in a 90 m^3 cell, performed respectively in CEA and CSTB facilities. The agreement between computation and experiments is very good in the first case, quite good in the second case.

25564 (LA—9911-C-Vol.1, pp 199-209) **Field model of fire and its application to nuclear containment problems.** Cox, G. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

This paper concentrates on developments in the deterministic field modelling of fire. The prediction method described is based upon a finite difference solution of the set of elliptic partial differential equations that express the conservation of mass, momentum, energy and other fluid variables in three dimensions. This gives local predictions of temperature, pressure, velocity and smoke concentration. Predictions of smoke movement are presented and compared with experimental data in naturally ventilated compartments. Improvements and future developments (incorporation of combustion and radiation) of the model and its application to forced ventilation nuclear installation buildings are discussed.

25565 (LA—9911-C-Vol.1, pp 211-230) **FIRAC: a computer code to predict fire accident effects in nuclear facilities. Volume I.** Bolstad, J.W.; Krause, F.R.; Tang, P.K.; Andrae, R.W.; Martin, R.A.; Gregory, W.S. (Los Alamos National Lab., NM). Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

FIRAC is a medium-sized computer code designed to predict fire-induced flows, temperatures, and material transport within the ventilating systems and other airflow pathways in nuclear-related facilities. The code is designed to analyze the behavior of interconnected networks of rooms and typical ventilation system components. This code is one in a family of computer codes that is designed to provide improved methods of safety analysis for the nuclear industry. This model provides transport source terms to the ventilation system that can affect its operation and in turn affect the fire. A basic material transport capability that features the effects of convection, deposition, entrainment, and filtration of material is included. The interrelated effects of filter plugging, heat transfer, gas dynamics, and material transport are taken into account. In this paper the physical models used to describe the gas dynamics, material transport, and heat transfer processes are summarized. How a typical facility is modeled using the code is illustrated.

25566 (LA—9911-C-Vol.1, pp 263-282) **Pressure transients in scale-model ventilation systems.** Martin, R.A. (Los Alamos National Lab., NM); Gregory, W.S.; Smith, P.R.; Ricketts, C.I. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Analytical and experimental studies of ventilation systems to verify the Los Alamos National Laboratory TVENT accident analysis computer code have been conducted for transient pressure conditions. TVENT was developed as a user-friendly analysis tool for designers and regulatory personnel; it was designed to predict pressure and flow transients in ventilation systems. The experimental studies used two relatively simple, yet sensitive, physical systems designed using similitude analysis. These physical models were instrumented end-to-end for pressure and volumetric flow rate and then were subjected to extreme transient pressure conditions of amplitude 18.5 kPa (2.68 psi) and pressurization rate 14.3 kPa/s (2.07 psi/s). Such conditions are more severe than fire-induced pressure transients but are less severe than explosion-induced pressure transients. We verified the TVENT code by showing that it successfully predicted our experimental results.

25567 (LA—9911-C-Vol.2, pp 391-404) **Solvent pool fire testing.** Malet, J.C.; Duverger de Cuy, G.; Gasteiger, R.; Janberg, K. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Pool fire tests were carried out to simulate certain types of fire liable to occur in fuel reprocessing plants with TBP-kerosene mixtures in quantities ranging from 2nd to 250 liters, with combustion areas fo 78 cm^2 to 5 m^2. Test results showed that a solvent pool can be ignited at temperatures below the flashpoint by propagation from a localized hot spot in case of very strong local energy input. The transfer coefficients from the mixture to the air and the very high efficiency filters were measured for cesium and thorium, used to simulate the plutonium that could be present in the solvent.

25568 (LA—9911-C-Vol.2, pp 467-477) **Interaction of fire and explosion with ventilation systems of fuel cycle plants.** Lillyman, E. (UKAEA, Dounreay, England). Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

This paper is mainly concerned with Fast Reactor Fuel Cycle Plants and Facilities at the Dounreay site of the UKAEA. Fire and explosion experience over the past 26 years is briefly reviewed followed by consideration of interactions between ventilation systems associated with typical fuel cycle facilities and fire protection. Conflicts of interest are identified between radiological and fire protection requirements. Current design philosophy and practice to deal with these situations is discussed.

25569 (LA—9911-C-Vol.2, pp 515-535) **Fire protection in ventilation systems and in case of fire operating ventilation systems.** Zitzelsberger, J. (Munich Technical Univ., Germany). Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The fire risks in ventilation systems are discussed. It follows a survey of regulations on fire prevention and fire protection in ventilation systems and smoke and heat exhaust systems applicable to nuclear installations in the Federal Republic of Germany. Fire protection concepts for normal systems and for systems operating also in case of fire will be given. Several structural elements for fire

protection in those systems will be illustrated with regard to recent research findings.

25570 (LA—9911-C-Vol.2, pp 537-543) **Conventional fire research and the safety of nuclear installations.** Nice, G.R. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Because of the complex nature of fire, a co-ordinated program of research into all aspects of fire and its effects is essential if misleading results are to be avoided. This procedure has been followed for some years in the United Kingdom and the resulting program is outlined. Suggestions are made as to how the procedure might be applied to fires in nuclear installations, together with a procedure for the assessment of fire hazard and the development of fire tests.

25571 **(PNL-SA—12198) Uranium mill tailings and risk estimation.** Marks, S. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 10p. (CONF-840488—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010705.

From Low level nuclear waste cleanup conference; Arlington, VA, USA (16 Apr 1984).

Work done in estimating projected health effects for persons exposed to mill tailings at vicinity properties is described. The effect of the reassessment of exposures at Hiroshima and Nagasaki on the risk estimates for gamma radiation is discussed. A presentation of current results in the epidemiological study of Hanford workers is included. 2 references. (ACR)

25572 **(SAND—83-7106) Preliminary post-emplacement safety analysis of the subseabed disposal of high-level nuclear waste.** Kaplan, M.F.; Koplik, C.M.; Klett, R.D. (Analytic Sciences Corp., Reading, MA (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011162.

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The radiological hazard from the disposal of high-level nuclear waste within the deep ocean sediments is evaluated, on a preliminary basis, for locations in the central North Pacific and in the northwestern Atlantic. Radionuclide transport in the sediment and water column and by marine organisms is considered. Peak doses to an individual are approximately five orders of magnitude below background levels for both sites. Sensitivity analyses for most aspects of the post-emplacement systems model are include. 25 references, 14 figures, 3 tables.

25573 **(UCRL—15575) Nuclear criticality safety analysis of a spent fuel waste package in a tuff repository.** Weren, B.H.; Capo, M.A.; O'Neal, W.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Waste Technology Services Div.). Dec 1983. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010990.

An assessment has been performed of the criticality potential associated with the disposal of spent fuel in a tuff geology above the water table. Eleven potential configurations were defined which cover a vast range of geometries and conditions from the nominal configuration at emplacement to a hypothetical configuration thousands of years after emplacement in which the structure is gone, the fuel pellets disintegrated and the borehole flooded. Of these eleven configurations, four have been evaluated at this time. The results of this evaluation indicate that even with very conservative assumptions (4.5 w/o fresh fuel), criticality is not a problem for the nominal configuration either dry or fully flooded. In the cases where the condition of the waste package is assumed to have severely deteriorated, over long times, calculations were performed with less conservative assumptions (depleted fuel). An assessment of these calculations indicates that criticality safety could be demonstrated if the depletion of the fissile inventory during fuel irradiation is taken into account. A detailed discussion of the calculations performed is presented in this report. Also included are a description of the configurations which were considered, the analytical methods and models used, and a discussion of additional related work which should be performed. 15 references, 11 figures, 8 tables.

0550 Regulations

REFER ALSO TO CITATION(S) 25449, 25484

25574 (CONF-830528—Vol.2, pp 1401-1406) **Cargo security: a review of physical security techniques for shipping radioactive materials.** Lamb, J.A. Sr. (Science Applications, Inc., Oak Ridge, TN). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Experience to date has demonstrated that shippers and carriers can comply with the various requirements in an effective manner. Many activities, such as notifications (consignee, state, etc.), and permits are administrative in nature. Other requirements, including inspections, maintenance, and use of special equipment can be coordinated with a good commercial carrier. Although this myriad of regulatory controls and procedures is disruptive in scheduling shipments and costly (as much as a 48 percent increase in some cases), safety is the primary objective. Since shipments of spent fuel from commercial power reactors will no doubt increase, it is recommended that: (1) shippers and carriers coordinate their efforts in the planning process for spent fuel shipments; the DOE, NRC, and DOE continue to work with the state regulatory agencies in developing procedures for the timely movement of spent fuel shipments and the protection of sensitive information related to schedules and routings; and (3) shippers use qualified carriers with good service records for all shipments of radioactive material. 6 references.

25575 (CONF-830528—Vol.2, pp 1407-1411) **How to implement physical protection measures for transport or how to sit most comfortable between two chairs.** Schueler, R. (Transnuklear GmbH, Hanau, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The author describes problems encountered by a specialized company, like Transnuklear, when it transports radioactive materials and the problems posed by the requirements of the catalogue of measures for physical protection.

25576 (CONF-830528—Vol.2, pp 1412-1421) **Goal system for comparative assessments of nuclear fuel transport under security aspects.** Behrendt, V.; Schwieren, G. (Dornier System GmbH, Friedrichshafen, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Due to the great hazard potential of nuclear fuel transports the possibility always exists during transportation that either a single perpetrator or a group of perpetrators will try to get possession of the nuclear fuel. One can assume that at the end of such illegal actions there will be a politically (or otherwise) motivated extortion. Thinking about security one has to face things like sabotage, attacks from inside or outside the system, robbery and/or dispersion of the transported goods. In respect to the security of nuclear transports we carried out an investigation for the German Ministry of the Interior in order to review the different levels of security of different transport systems. This paper deals with the methodological approach, especially with the goal system and the way we executed the investigation.

25577 (CONF-830528—Vol.2, pp 1422-1424) **Physical security measures for the transportation of specially categorized nuclear material.** Alter, U. (Gesellschaft fuer Reaktorsicherheit (GRS) mbH, Koeln, Germany); Herkommer, E.; von Dobschuetz, P. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The most important requirements are presented that have to be met by a vehicle for the transport on road of nuclear fuel belonging to Category I (Integrated Container Vehicle). The technical realization of such a vehicle is shown by means of examples.

25578 **(DOE/NBM—1073-Vol.2) US statutes of general interest to safeguards and security officers. Volume 2. Text of Atomic Energy Act, Executive Orders and other laws.** (Brookhaven National Lab., Upton, NY (USA)). Nov 1983. Contract AC02-76CH00016. 248p. NTIS, PC A11; 3; GPO Dep. Order Number DE84008599.

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This handbook has been prepared to provide DOE safeguards and security professionals with citations from relevant US laws, Executive Orders, and other sources. It updates the US Statutes of General Interest to Security Officers in the Atomic Energy Program, of January 1970. It will also prove useful to others who have safeguards and security responsibilities who need to be able to cite the authorities under which the safeguards and security program operates. The revisions reflected in the present issue of the handbook include principally amendments of the Atomic Energy Act and the Internal Security Act as well as many additions and deletions. The texts of the statutes reproduced in the handbook are not intended to be an exhaustive compilation of federal laws of interest to security inspectors and others in the US DOE, but are intended to reflect those statutes, of administrative as well as penal aspect, which have proved to be of recurrent concern and application. The texts of laws contained in the handbook are presented in the order indicated by the Outline of Contents. Each text is followed, where pertinent, by cross-references to texts of other statutes, and by comments on the application of such laws to the Atomic Energy program. The handbook is also provided with an Index to Definitions and Statutory Concepts, as well as a new subject index and index by US Code number.

25579 **(LA—9936-MS) Deadtime reduction in thermal neutron coincidence counter.** Swansen, J.E. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011001.

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Two areas for reducing coincidence deadtime have been investigated, analog and digital. The analog work includes use of a commercially available hybrid preamplifier discriminator useful to at least 150 kpps/channel with present detectors and added circuitry for combining multiple channels. The digital work includes reducing OR gate deadtime and the introduction of a derandomizing buffer at the input of the shift-register section. Providing benefits to 1 Mpps, the combined efforts of this work have reduced the six-channel coincidence deadtime from $\sim$ 2.4 to $\sim$ 0.7 μs. 2 references, 14 figures.

25580 **(PNL-SA—11842) Analyzing prompt accountability data to establish alarm thresholds.** Eggers, R.F.; Kinnison, R.R.; Smith, B.W.; Brouns, R.J. (Pacific Northwest Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1983. Contract AC06-76RL01830. 5p. (RHO-SS-SA—10; CONF-831106—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011269.

From Topical meeting on safeguards technology - the process safeguards interface; Hilton Head Island, SC, USA (28 Nov 1983).

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Several alternative methods for establishing alarm thresholds to detect an abrupt loss of bulk nuclear material have been evaluated. Both parametric and non-parametric statistical procedures have been used to characterize the cumulative distribution functions (CDFs) of loss estimator data produced by actual unit process operations. Most prompt accountability data observed thus far appear to be non-normally distributed and may better be represented by a linear combination of parametric probability density functions than by a single normal density function. However, a single normal probability model can be used in most cases to establish the abrupt-loss detection alarm threshold for detector up to detection probabilities of about 90%. 6 references, 2 figures.

25581 **(SAND—84-0964C) Further development of international safeguards.** de Montmollin, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 14 May 1984. Contract AC04-76DP00789. 10p. (CONF-840531—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010601.

From 6. annual symposium on safeguards and nuclear material management; Venice, Italy (14 May 1984).

A promising area for technical development, leading to new safeguards approaches, is the further use of unattended instruments to make more effective use of inspector resources and to reduce intrusiveness. An unattended liquid-level monitor for reprocessing-plant accountability tanks was tested under the TASTEX program. With secure data recording, it can provide continuous coverage while the resident inspector is engaged in other tasks. Another development is for monitoring the feed and withdrawal streams at centrifuge enrichment plants. Unattended and protected instruments to measure enrichment of the feed, product, and tails streams, and the identification, gross and tare weights of cyclinders can provide a continuous record with only intermittent inspector presence. To reduce the number of interim inspections at LWR's, we are studying collection of surveillance information in secure, detachable TV data packages and having the operator send them to the Agency for review to detect any changes in the spent-fuel inventory. If it could not be verified that there had been no changes, an interim inspection would be made within the present three-month limit. Otherwise, the inspection could be deferred, with the annual inspection performed on schedule. We are looking at the hardware feasibility and tamper-resistance aspects, and the expected savings of inspector effort. After we have a clearer understanding of what might be done, the questions of adequacy and acceptability can be addressed by the proper authorities. These examples demonstrate how innovation by the technical community can open new safeguards approaches for consideration by the Agency.

25582 **Capacitive label reader.** Arlowe, H.D. (to Dept. of Energy). US Patent Application 6-514,126. 15 Jul 1983. 18p. Contract AC04-76DP00789.

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A capacitive label reader includes an outer ring transmitting portion, an inner ring transmitting portion, and a plurality of insulated receiving portions. A label is the mirror-image of the reader except that identifying portions corresponding to the receiving portions are insulated from only one of two coupling elements. Positive and negative pulses applied, respectively, to the two transmitting rings biased a CMOS shift register positively to either a 1 or 0 condition. The output of the CMOS may be read as an indication of the label.

25583 **Laser induced phosphorescence uranium analysis.** Bushaw, B.A. (to Dept. of Energy). US Patent Application 6-503,130. 10 Jun 1983. 7p. Contract AC06-76RL01830.

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A method is described for measuring the uranium content of aqueous solutions wherein a uranyl phosphate complex is irradiated with a 5 nanosecond pulse of 425 nanometer laser light and resultant 520 nanometer emissions are observed for a period of 50 to 400 microseconds after the pulse. Plotting the natural logarithm of emission intensity as a function of time yields an intercept value which is proportional to uranium concentration.

06 FUSION FUELS

0601 Sources

25584 **Homogenous tritium production reactor.** Cawley, W.E. (to Dept. of Energy). US Patent Application 6-500,107. 1 Jun 1983. 7p.

Portions are illegible in microfiche products.

A method and apparatus are described for the joint production and separation of tritium. Tritium is produced in an aqueous homogenous reactor and heat from the nuclear reaction is used to distill tritium from the lower isotopes of hydrogen.

0602 Processing

25585 (RL—83-069, pp vp) **Proposed method of hydrogen isotope separation using palladium alloy membranes.** Evans, J.; Harris, I.R. (Birmingham Univ. (UK). Dept. of Physical Metallurgy and Science of Materials); Ross, D.K. (Birmingham Univ. (UK). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

The viability of using palladium alloy membranes in cascade to separate the H, D and T produced in a fusion reactor is discussed. Values of the permeation separation factor are estimated for Pd - 20% Ag from available data and corresponding estimates for the necessary number of stages and the total membrane area are given for the required isotopic purification. The results demonstrate the advantage of minimising the operating temperatures and pressures and indicate that the method is perfectly feasible. The use of Pd - 8% Y will probably even further improve the performance.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

25586 **Capability of the electromagnetic isotope enrichment facility at ORNL.** Newman, E. (Oak Ridge National Lab., TN). pp 403-408 of Synthesis and application of isotopically labeled compounds. Duncan, W.P.; Susan, A.B. (eds.). Amsterdam, Netherlands; Elsevier Scientific Publishing Co. (1983). Contract W-7405-ENG-26.

From International symposium on synthesis and applications of isotopically labeled compounds; Kansas City, MO, USA (6 Jun 1982).

The isotope separation program at Oak Ridge National Laboratory (ORNL) prepares and distributes electromagnetically enriched stable isotopes to the worldwide scientific community. Among the topics discussed in the present paper are the methods of enriching isotopes, the limitations that apply to the quantity and final assay of the separation products, and a generalized production flowsheet indicating the capability of the facility. A brief description of each of the production steps, from the selection and preparation of initial feedstock to the recovery and distribution of the isotopically enriched material, is presented. The future of the facility, the continued supply of enriched isotopes, and the response of the program to new and changing requirements are emphasized.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 27153

0703 Isotopic Power Supplies

25587 **(LA—10057-PR) Space nuclear safety program. Progress report, October 1983.** Bronisz, S.E. (comp.). (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011015.

This technical monthly report covers studies related to the use of $^{238}PuO_2$ in radioisotope power systems carried out for the Office of Special Nuclear Projects of the US Department of Energy by Los Alamos National Laboratory.

25588 **Alloys for nuclear power systems in space.** Cooper, R.; Inouye, H. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 83-87(Fal 1983).

One of the more critical components of spacecraft is the power supply that provides electricity for the instruments that navigate, communicate and explore. Because power supply systems on unmanned spacecraft cannot be repaired, they are designed for high reliability. The development of the iridium-tungsten alloy used to contain the nuclear fuel for the recent Voyager missions to Jupiter and Saturn is discussed. ORNL research on testing different alloys for possible use in small reactors being designed for advanced civilian applications such as an orbiting space station and for national defense applications including radar and laser systems in outer space is described.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 25188, 25189, 25190, 25191, 27562

25589 **(DOE/ET/00085—T1) Producing hydrogen with a bacteriorhodopsin solar energy cell. Final technical report.** Lewis, A. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). 3 Jan 1984. Contract FG02-79ET00085. 17p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008312.

Bacteriorhodopsin-based solar cells have the following potential advantages over liquid-junction cells: Bacteriorhodopsin is very resistant chemically and is also resistant to high photon fluxes. Even though the efficiency of the experimental solar cell is still low, the theoretical efficiency, as determined from experiments is high (about 60%). The device would use inexpensive materials that are not limited in supply. The absorption properties of bacteriorhodopsin can be easily manipulated chemically or genetically to improve its characteristics in a solar cell.

25590 **(ORNL/TM—7378) Engineering scoping study of the production of hydrogen and oxygen from the cerium oxide-sodium phosphate/carbonate thermochemical cycle.** Goeller, H.E. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010629.

One potential industrial application of solar energy is for the production of hydrogen (and oxygen) using a cycle of thermochemical reactions. This report provides a preliminary evaluation of the engineering feasibility of such an operation based on the cerium oxide-sodium phosphate/carbonate thermochemical cycle to produce 2 metric tons of hydrogen per day. Material and heat balances were developed, and equipment was sized. The preliminary pilot plant layout was then compared with a plant of the same capacity for producing hydrogen by the electrolysis of water. The use of water electrolysis seems superior and cheaper in all respects. 7 figures, 4 tables.

25591 (SERI/CP—231-2075, pp 17-32) **Study of hydrogen production by tropical marine photosynthetic bacteria for applied systems. Part III.** Mitsui, A.; Kumazawa, S.; Ikemoto, H. (Univ. of Miami, FL). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

During the past year, photosynthetic sulfur bacterium, Chromatium sp. strain Miami PBS 1071, from our laboratory culture collection was studied for practical application.

25592 (SERI/CP—231-2075, pp 33-45) **Light and dark production of hydrogen by photosynthetic bacteria.** Weaver, P.F.; Maness, P.C.; Schultz, J.E. (Solar Energy Research Inst., Golden, CO). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

A H_2-evolving hydrogenase, distinct from an uptake hydrogenase, has been found in several species of photosynthetic bacteria and operates both in light and darkness. The second hydrogenase is present in photosynthetically, fermentatively, or anerobically respir-

ing cultures, but not those exposed to air. Although the equilibrium pressure for the evolving hydrogenase is 0.1 to 0.2 atmosphers H_2, we believe it can be coupled by interspecies H_2 transfer to methanogens resulting in a photoenhancement of anaerobic digestion. The uptake hydrogenase can be observed to couple to a novel, diheme c-type cytochrome under anaerobic dark, respiratory conditions. This membrane-bound cytochrome can be derepressed to extremely high concentrations. There are 2.0 hemes per minimum molecular weight of 44 kdaltons. When bound, one heme has a midpoint potential of -235 mV and binds CO, while the second heme is at +6 mV, does not bind CO, and is reduced by NADH. A cell-free assay for nitrogenase is being developed in which endogenous reductants and light-driven ATP synthesis are coupled to nitrogenase activity. An essential component for this assay is an uncharacterized periplasmic factor which when concentrated reconstitutes activity more than 100-fold over crude extracts. 5 references, 6 figures.

25593 (SERI/CP—231-2075, pp 47-61) **Photobiological production of hydrogen by photosynthetic bacteria.** Wall, J.D.; Love, J.; Quinn, S. (Univ. of Missouri, Columbia). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

The production of H_2 from waste carbon sources using the photosynthetic bacteria is an ecologically sound process for photobiological H_2 generation from biomass. To maximize this process, a genetic approach has been taken for the introduction of desirable characteristics into the genetically accessible strain Rhodopseudomonas capsulata. Three areas of the metabolism of this bacterium have received attention in these studies: the uptake hydrogenase which oxidizes H_2; the nitrogenase enzyme complex which irreversibly produces H_2; and the substrates available for catabolism which supply reducing equivalents for H_2 generation. During the course of the generation of mutants lacking active nitrogenase (Nif^-) for the examination the regulation of this system, an attempt to isolate spontaneous mutants was made. The selection procedure was based on the hypothesis that R. capsulata growing with an organic nitrogen source, such that nitrogenase was derepressed and H_2 was being produced, would be at a selective disadvantage as compared to a Nif^- mutant which was unable to generate H_2 thus conserving energy and electrons. To our amazement, Nif^- mutants were strongly selected by photosynthetic growth in minimal medium containing glutamate as nitrogen and became a few percent of the population of cells within 3 to 4 daily subcultures. Subsequently they rapidly took over the culture becoming > 95% by 10 days. The characterization of a frequently occurring spontaneous Nif^- mutant will be presented. Previous work using the antibiotic metronidazole which appeared to be strongly selective for Nif^- mutants can now be rationalized in light of these findings.

25594 (SERI/CP—231-2075, pp 63-73) **Genetic engineering of photosynthetic hydrogen evolution in heterocystous blue-green algae.** Spiller, H.; Sankar, P.; Shanmugam, K.T. (Univ. of Florida, Gainesville). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

The major objective is to maximize the rate of H_2 production by cyanobacteria. As a first step towards this goal, we have attempted to understand the basic physiology of H_2 metabolism in the cyanobacterium, Anabaena variabilis and the heterotrophic bacterium, Escherichia coli. In these studies, E. coli is used as a model system to elucidate the H_2 metabolism in a living cell. During the last year, we have determined the actual distribution of hydrogenase activities between the vegetative cells and heterocysts. An understanding of the distribution and regulation of the two hydrogenase activities allowed us to isolate and characterize H_2 uptake defective mutants of A. variabilis. We have also isolated mutant strains that are capable of producing nitrogenase even in the presence of NH_4^+. These results are presented in the next section. 6 references, 1 figure, 7 tables.

25595 (SERI/CP—231-2075, pp 75-88) **Photo/biological production of hydrogen and oxygen. Progress report, June 1982-May 1983.** Greenbaum, E. (Oak Ridge National Lab., TN). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—). Contract W-7405-ENG-26.

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

Three advances in photobiological hydrogen and oxygen production were made. Using an original experimental technique, photosynthetic light saturation curves for the steady-state simultaneous photoproduction of molecular hydrogen and oxygen have been measured for the first time. Both in vitro and in vivo systems have been studied. The in vitro system was composed of isolated spinach chloroplasts, ferredoxin, and hydrogenase. The in vivo systems were the anaerobically adapted intact eukaryotic green algae Scenedesmus D_3 and Chlamydomonas reinhardtii. Photosynthetic bacteria are capable of high rates of hydrogen production using energy-rich organic compounds as the primary substrate. These high rates and the ATP-dependent nature of their hydrogen production make them interesting organisms to study both from their potential practical applications as well as the fundamentals of energy transduction photoprocesses. We have measured hydrogen production by a photosynthetic bacterium (R. sphaeroides, P. Weaver, SERI) using repetitive flash illumination. Experiments designed to test the long-term capability of green algae for oxygen and hydrogen photoproduction have been continued. These experiments were carried out using a culture of Chlamydomonas reinhardtii, which had been recultured in minimal medium using the bleached cells from a previous experiment as an inoculum. 25 references, 4 figures.

25596 (SERI/CP—231-2075, pp 89-104) **Biochemical and physiological characterization of hydrogenase and hydrogen metabolism in microalgae.** Lien, S.; Roessler, P. (Solar Energy Research Inst., Golden, CO). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

Results are presented from studies on: purification of hydrogenase; biochemical characterization of hydrogenase in vitro; and physiological function of hydrogenase. 17 references, 6 figures, 2 tables.

25597 (SERI/CP—231-2075, pp 105-117) **Water-splitting photosystem II preparations from spinach: structural, biochemical, and biophysical properties.** Seibert, M. (Solar Energy Research Inst., Golden, CO). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—). Contract AC02-77CH00178.

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

The approach taken to better understand the photosynthetic water-splitting process has been three-fold, encompassing structural, biochemical, and biophysical studies of oxygen-evolving PS II preparations isolated from spinach. This system was chosen because PS II is very easy to isolate, O_2 evolution rates are very high, and the system is quite stable at room temperatures. 48 references, 3 figures, 1 table.

25598 (SERI/CP—231-2075, pp 119-137) **Photo-Kolbe reaction in biomass wastestreams.** Schwerzel, R.E.; Byker, H.J.; Iden, R.B.; Vutetakis, D.G.; Wood, V.E. (Battelle Columbus Labs., OH). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

The results presented demonstrate that the photo-Kolbe reaction is part of a much more complex series of reactions than might be anticipated at first sight. A number of competing processes serve to lower the efficiency of hydrocarbon formation, and the search for conditions which will provide a high yield of hydrocarbons under illumination with visible light has so far proved unrewarding. The finding that the photo-Kolbe reaction fails to occur on so many types of un-derivatized semiconductor powders is particularly disappointing, as the large-scale production of hydrocarbon fuels with platinized powders would appear to be economically prohibitive. This problem might be alleviated, at least to some extent, by the use of metals other than platinum or by the use of other surface-modification techniques; the photoelectrochemical behavior of such powders is largely unexplored, however. The prospect of producing fuels for heating and transportation from renew-

able resources and solar energy by means of the photo-Kolbe reaction remains appealing, but at present the realization of this promise seems far from assured. 23 references, 6 figures, 6 tables.

25599 (SERI/CP—231-2075, pp 139-144) **Hydrogen container materials research.** Webb, J.D. (Solar Energy Research Inst., Golden, CO). Nov 1983. NTIS, PC A07/MF A01. (CONF-8305137—).

From Photo/biological hydrogen annual review meeting; Golden, CO, USA (20 May 1983).

The concept of a deep-pond reactor for anaerobic production of hydrogen using photosynthetic bacteria (PSB) has been demonstrated as the most economical of the reactor design proposals evaluated to date. The PSB-containing ponds will require a flexible, weatherable, solar-transparent cover that will retain hydrogen produced in the pond. The cover must also be impermeable to atmospheric oxygen, and must be held in place by a series of parallel, evenly spaced support cables. Several of the so-called barrier polymers may satisfy these requirements. To select potential cover materials from the several weatherable barrier polymers available in film form, the design stress on the cover for 1.2 m (4.0 ft) cable spacing and 1.7 kPag (0.25 psig) pressure was calculated. Cover thickness was chosen from thicknesses available commercially for each material so that yield strength exceeded design stress. Hydrogen permeation rate was then calculated for each material, using manufacturer's permeability data and a partial H_2 pressure of 0.67. The estimated daily H_2 losses, the solar transmittance, and the cost of each proposed cover material were used to estimate the cost of H_2 produced from a PSB reactor employing that material. It was found that two candidate materials, biaxially oriented Kynar (3M) and Tedlar (Dupont), would be economical choices to meet the design criteria. The former material is in the pilot plant development stage, while the latter is currently available in commercial quantities. Another potential cover material, Barex (Sohio), is being investigated. Samples of materials passing the screening procedures described above will be subjected to testing at SERI to verify H_2 and O_2 permeation rates given by the manufacturers. 4 references, 1 figure, 1 table.

0802 Storage

25600 (CONF-840702—7) **Coated silica shells: an advanced hydrogen storage system.** Henderson, T.M.; Martin, A.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1984. Contract AC08-82DP40152. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008986.

From 5. world hydrogen energy conference; Toronto, Canada (15 Jul 1984).

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We have investigated a new concept for the storage of hydrogen gas. It consists of storing hydrogen on a bed of small metal-coated spherical shells of nearly pure silica composition. The silica shells function as high pressure containers which because of silica's high strength, can withstand the pressures required to achieve significant gas storage densities. Since pure silica is too permeable to adequately retain hydrogen, a metal (e.g., Ni, Cu, Mo) coating is added as a room temperature permeation barrier. Fortunately, the rate at which hydrogen permeates these metals varies rapidly with temperature. Consequently, to cause the hydrogen to readily permeate the metal coating as well as the silica shell requires heating the bed to only moderate temperatures.

25601 **Iron-titanium 'sponge' can store hydrogen for vehicles, powerplants.** Reilly, J.J. (Brookhaven National Lab., Upton, NY). *Chemical Week;* **122**: No. 14, 36(5 Apr 1978).

According to J.J. Reilly (Brookhaven Natl. Lab.) at a joint meeting of the American Physical Society and Biophysical Society, such storage devices could help make hydrogen-powered vehicles and hydrogen-fueled electrical powerplants a reality by eliminating dependence on bulky and potentially dangerous storage cylinders for compressed hydrogen, which would be generated by coal, and eventually from water by nuclear, solar, or geothermal energy. Reilly described an experimental device, now being tested by New Jersey's Public Service Electric and Gas Co., into which hydrogen is pumped to form hydrides; when the pressure in the device is reduced and the system is heated, the alloy releases hydrogen atoms, which recombine to form molecular hydrogen.

0808 Properties

REFER ALSO TO CITATION(S) 26570

25602 (LBL—13500, pp 4.63-4.65) **Collision dynamics studies of selected hydrogen/oxygen reactions.** Brown, N.J.; Miller, J.A.; Rashed, O. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

09 OTHER SYNTHETIC AND NATURAL FUELS

25603 **(LBL—13500) Energy and Environment Division, annual report, FY 1981.** (Lawrence Berkeley Lab., CA (USA)). Sep 1982. Contract AC03-76SF00098. 342p. NTIS, PC A15/MF A01. Order Number DE83004093.

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The Chemical Process R and D Program is investigating four major research areas: (1) bioconversion of cellulose to liquid fuel; (2) production of synthetic fuels from fossil fuels; (3) electrochemical energy storage; and (4) environmental protection from the hazards of synthetic-fuel production. The Solar Program consists of a number of applied and basic research projects, including: (1) active solar cooling of buildings; (2) passive solar heating and cooling; (3) the conversion of solar energy to electricity, e.g., by means of the Small Particle Heat Exchange Receiver (SPHER); and (4) the photochemical conversion of sunlight to energy. The efficient use of energy in buildings is the emphasis of the Energy Efficient Buildings Program (EEB), which comprises the following related groups: (1) Building Envelopes; (2) Efficient Windows and Daylighting; (3) Efficient Artificial Lighting; (4) Ventilation and Indoor Air Quality; (5) Building Energy Simulation using the DOE-2 computer model; and (6) Building Energy Data Compilation and Analysis. The objective of the Environmental Research Program is to study the hazardous effects of energy generation and use. The program is divided into seven major research areas that encompass transport and transformation, impacts, characterization, and abatement. These major areas are: (1) Atmospheric Aerosol Research; (2) Laser Spectroscopy; (3) Combustion Research; (4) Oil Shale Research; (5) Lake Ecotoxicology and Acid Rain; (6) Instrumentation Survey; and (7) Trace Element Analysis. The Energy Analysis Program is organized into four study areas: (1) building energy use; (2) energy and peak demand forecasts; (3) international energy demand; and (4) energy supply. Each report has been identified for inclusion in the Energy Database.

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 25622

25604 (ANL/CNSV-TM—127, pp 13-16) **Gasifiers - past, present and future.** Ayres, W.A. (Buck Rogers Co., Inc., Industrial Airport, KS). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The history of gasifier development for steam and electric power generation in the US is briefly summarized. Projects currently underway at the Buck Rogers Co., Inc. to develop a workable air gasification system are described. The availability and cost of wood chips are estimated for the continental US. (DMC)

25605 **(CONF-8310252—) Proceedings of the DOE contractors' conference on indirect liquefaction.** (USDOE Pittsburgh Energy Technology Center, PA). 1983. 412p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE84005789.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

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An Indirect Liquefaction Contractors' Conference was held on October 12-13, 1983 at the Holiday Inn/Greentree, Pittsburgh, PA. The meeting was held for the purpose of reviewing the status of research and development work being sponsored by the DOE in support of Indirect Liquefaction Technology process development. A second purpose was the promotion of a technical exchange among the DOE contractors and PETC in-house research personnel and the gaining of insight into how individual projects dovetail to support the overall program. Specific objectives intended were: to review updated project results, to enable contractors working in the subject area to discuss and exchange information, and to provide DOE's input into the review of the subject area. Fifteen papers have been entered individually into EDB and ERA. (LTN)

25606 (CONF-8310252—, pp 1.1-1.43) **Two-stage slurry Fischer-Tropsch/ZSM-5 process of converting syngas to high octane gasoline.** Kuo, J.C.W.; Leib, T.M.; Gupte, K.M.; Smith, J. (Mobil Research and Development Corp., Paulsboro, NJ). 1983. NTIS, PC A18/MF A01. Contract AC22-80PC30022.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

We have recently completed the initial phase of development studies for conversion of synthesis gas to high octane gasoline via a two-stage slurry F-T/ZSM-5 process. A long-term stability and produced 815 gHC/gFe in eighty-six days. Effects of feed H_2/CO ratio, pressure, and feed-gas velocity were studied. The addition of a potassium-salt to reduce methane + ethane yield was also demonstrated. A second-stage ZSM-5 catalyst performed well, converting the F-T products into high quality gasoline in one step. It accumulated eighty-seven days on-stream-time with two regenerations. The gasoline product showed satisfactory oxidation stability. Methane + ethane selectivities as low as 2 to 5 wt % for the F-T synthesis were demonstrated by using either higher pressure and/or lower temperature or a new catalyst. The liquid hydrocarbon yield was maximized in this case; however, reactor-wax yields as high as 85 wt % were obtained. An on-line settling method was demonstrated to effectively separate a low solid-content reactor-wax from the catalyst slurry. A conceptual process design and scoping cost estimate for a battary-limit 27,000 BPSD gasoline plant from clean synthesis gas was conducted.

25607 (CONF-8310252—, pp 2.1-2.38) **Catalyst and reactor development for a liquid phase Fischer-Tropsch process: indirect liquefaction catalyst development.** Bauer, J.V.; Brian, B.W.; Dyer, P.N.; Pierantozzi, R. (Air Products and Chemicals, Inc., Allentown, PA). 1983. NTIS, PC A18/MF A01. Contract AC22-80PC30021.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Previous studies have pointed out the advantages in thermal efficiency and economics that may be gained by coupling advanced gasifiers, which produce little or no methane and a CO rich syngas, with a slurry phase Fischer-Tropsch (FT) unit such as the one operated by Kolbel at Rheinpreussen. The particular advantages of the Kolbel slurry phase FT process are: Its ability to accept CO rich syngas without external shift, high selectivity to liquid fuels, in Kolbel's case gasoline range hydrocarbons, with correspondingly low yields of CH_4 and C_2, high single pass conversion, reducing the need for syngas recycle, and increased thermal efficiency in removing and recovering the exothermic heat of reaction. In 1980, Air Products, under contract to the DOE, began an experimental program to investigate the slurry phase FT process. The overall objective was to evaluate catalysts and a slurry reactor system for the selective conversion of syngas into transportation fuels via a single stage, liquid phase process. The diesel fuel selectivity of catalysts developed in this work approaches or exceeds the SF maximum. Without further increase in catalyst activities, the space time yield of diesel fuel product under Rheinpreussen conditions is predicted to be 3 to 5 times higher than that observed by Kolbel. 13 references, 14 figures, 8 tables.

25608 (CONF-8310252—, pp 3.1-3.23) **Fischer-Tropsch synthesis in slurry reactor systems.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge). 1983. NTIS, PC A18/MF A01. Contract FG22-81PC40771.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

The objective of this work is to establish a quantitative understanding of the mass transfer-related factors that determine selectivity and reaction rate in a slurry reactor. By use of a mechanically-stirred autoclave that can be operated as a isothermal CSTR, to reliably compare and contrast the performance of specified catalysts. New data and reexamination of several previous studies in either vapor-phase or liquid-phase reactors with iron catalysts show a Flory carbon number distribution that exhibits a marked break at about C_{10}. At higher carbon numbers hydrocarbons are produced with a much higher probability of chain growth (α) than for lower carbon numbers. Total product distribution based on light product analysis may therefore be in substantial error. Results are interpreted in terms of a two-site catalyst structure. With a precipitated Mn/Fe catalyst, the olefin/paraffin ratio of the products at all carbon numbers was less than that with a reduced fused magnetite catalyst containing 0.4 to 0.8 wt % K_2O and the β-olefin/α-olefin ratio was much greater. Secondary hydrogenation and olefin isomerization reactions appear to be much more significant with the Mn/Fe catalyst. With both catalysts the Flory distribution was followed but in each case two values of the chain growth probability, α, were found, with a sharp increase above about C_{11}. 19 figures.

25609 (CONF-8310252—, pp 4.1-4.28) **Iron-manganese Fischer-Tropsch catalysts.** Tischer, R.E.; Pennline, H.W.; Zarochak, M.F.; Anderson, R.R. 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Various techniques were explored for the preparation of iron/manganese Fischer-Tropsch catalysts. Large surface area manganese oxides or iron/manganese oxides can be prepared but activation of the catalyst causes transformations which greatly reduce the catalysts surface area. A series of 10 Fe/90 Mn catalysts were prepared via different precursors and tested in a microreactor. A large variation in activity was observed for the various catalysts with a catalyst prepared via carbonate precipitation having the best activity and selectivity to liquid product in the gasoline range. Six catalysts with iron/manganese ratios of 100/0, 57/43, 44/56, 22/78, 10/90, and 0/100 were investigated in a slurry reactor after a standard activation procedure and at identical process conditions. Of these iron-manganese catalysts, the 20/80 and 10/90 have the most stability although deactivation with time on stream occurs with all the catalysts.

25610 (CONF-8310252—, pp 5.1-5.24) **Assessment of the use of slurry reactors in Fischer-Tropsch synthesis.** De Deken, J.C.; Ushiba, K.K. (Catalytica Associates, Inc., Mountain View, CA). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

The major technological problems of Fischer-Tropsch processes are the rapid and efficient removal of the reaction heat to avoid local overheating of the catalyst (and hence excessive methane formation), and the ability to operate with synthesis gas having low H_2-to-CO ratio to reduce cost and increase thermal efficiency of production, without leading to excessive carbon formation. This paper briefly reviews the various reactor types that have been developed to solve these problems compares some of the key features of the three major reactor technologies, and focuses on the ability of slurry-phase operation to handle low H_2-to-CO feed ratios. Although slurry-phase operation appears attractive, commercialization of slurry bubble column reactors still awaits reliable scale-up and design rules. There is limited knowledge of the factors that influence the flow regime, the degree of mixing in both liquid and gas phase, and the design parameters for slurry bubble column reactors. 30 references, 5 figures, 4 tables.

25611 (CONF-8310252—, pp 7.1-7.23) **Fischer-Tropsch bubble-column hydrodynamics.** Leib, T.M.; Smith, J.; Gupte, K.M.; Kuo, J.C.W. (Mobil Research and Development Corp., Paulsboro, NJ). 1983. NTIS, PC A18/MF A01. Contract AC22-80PC30022;AC22-81PC30019.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

In an effort to better understand the hydrodynamics in Fischer-Tropsch (F-T) bubble-column reactors, limited experiments were carried out to measure the average gas holdup in two short hot-flow columns (3.2 and 5.3 cm ID x 215 cm L). In addition, gas holdup and catalyst concentration profiles were measured in a tall bubble-column reactor (5.2 cm ID x 762 cm L). Preliminary results show that the type of liquid, gas distributor design, static liquid height and gas superficial velocity have major effects on gas holdup. For instance, F-T waxes have significantly higher gas holdups than hexadecane although they have similar viscosity and surface tension. Sintered plate gas distributors produce markedly higher gas holdups than single-orifice distributors; also, significant foaming is observed with sintered plates, while little or no foaming is present with single orifices. Decreasing static liquid height and/or increasing gas superficial velocity result in increased gas holdup. In the reactor, gas holdup profiles were shown to follow a three-zone pattern; this pattern was observed before only in cold flow experiments. Lastly, gas holdups were shown to be stable and at acceptable levels during an 86 day synthesis run. To further study these hydrodynamic phenomena, experiments are planned in two tall hot-flow columns (5.1 and 10.2 cm ID x 915 cm L) currently under construction, and in the bubble-column reactor.

25612 (CONF-8310252—, pp 8.1-8.20) **Slurry reactor hydrodynamic studies.** Bauer, J.V.; Brian, B.W.; Dyer, P.N.; Pierantozzi, R. (Air Products and Chemicals, Inc., Allentown, PA). 1983. NTIS, PC A18/MF A01. Contract AC22-80PC30021.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Air Products is nearing completion of a DOE contract, in which new diesel fuel selective catalysts and slurry phase bubble column reactor correlations for the Fischer-Tropsch (FT) synthesis were developed. The objective of the slurry reactor modelling studies was to evaluate, through the use of cold flow simulators, the hydrodynamics, flow characteristics and behavior of slurry reactors for the production of hydrocarbons from synthesis gas. The variables studied cause substantial differences in reactor performance, and thus plant costs. From a study of these parameters, uncertainty in the optimum reactor design was considerably reduced. There is some disagreement in the literature on whether the production rates in a FT slurry reactor are limited by mass transfer resistance, i.e., the rate at which reacting gas can transfer into the liquid phase, or by kinetic resistance, i.e., the kinetic reaction rate of the catalyst. Gas holdup, average bubble size, and mass transfer coefficient - all affect the degree in which the overall reaction is limited by mass transfer. If gas-liquid mass transfer limitations are controlling, then these would be the only parameters needing study. Two parameters, solids dispersion and liquid dispersion, affect the maximum catalyst loaded, and would be the only parameters needed to quantify STY for the kinetic controlled regime. The heat transfer coefficient determines how much heat transfer surface is required inside the reactor, which directly affects how much volume remains for the reaction. It is anticipated that, in the optimum bubble column design, mass and kinetic resistances, and possibly heat transfer resistances, may be controlling. Thus, it is necessary to quantify all of the above mentioned parameters. 13 references, 5 figures, 4 tables.

25613 (CONF-8310252—, pp 9.1-9.28) **Slurry bubble column dynamics.** Smith, D.N.; Ruether, J.A.; Stiegel, G.J. 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

A novel approach utilizing an electrical conductivity twin-probe technique is described for obtaining important gas-phase characteristics, such as bubble size, velocity, and holdup fraction. A 10-cm-internal-diameter by 310-cm-high glass column is employed to investigate the bubble dynamics measured with this probe. The liquid phase is composed of a mixture of ethanol and water that may have substantial surface activity that results in a dynamic surface tension effect on the rate of bubble coalescence. Measurements of gas holdup, bubble size, and velocity indicate the influence of surface activity on the gas phase characteristics. Possible implications of these results on the hydrodynamics of Fischer-Tropsch reactors are given. An experimental technique and subsequent analysis have been developed to determine the bubble size and velocity distributions in a slurry bubble column cold model. Dynamic surface tension effects have been observed for a two-component liquid mixture. The maximum frothing ability of a surface-active species qualitatively agrees with a dynamic surface tension model. Increased gas holdup and interfacial area are observed with the addition of a surface-active component. In addition, increased gas holdup and interfacial area are observed with a sintered plate compared to a perforated plate. The presence of solids reduces the gas holdup and increases the bubble size. 11 references, 11 figures.

25614 (CONF-8310252—, pp 11.1-11.19) **Liquid hydrocarbon fuels from syngas.** 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

This contract calls for the direct catalytic conversion of syngas to liquid motor fuels with product selectivities and quality superior to those provided by the Fischer-Tropsch process. The catalyst consists of a Fischer-Tropsch metal component (MC) and a shape selective molecular sieve component (SSC) to control hydrocarbon boiling range and quality. Task 1 is aimed at the screening of molecular sieves as SSC candidates using small olefins as feed while in Task 2 the syngas is directly converted to liquid fuels using a combined MC + SSC catalyst system. At present, the Task 1 has been successfully completed and the work is now concentrated on the optimization of several MC-SSC catalyst systems. Catalysts comprised of promoted iron and either of Union Carbide's Molecular Sieves 101 or 104 produce primarily gasoline range hydrocarbons from syngas. Cobalt-containing catalysts, while producing more methane, have produced at least as much gasoline and more diesel oil than comparable iron-containing catalysts. On a methane-free basis, promoted cobalt and either of Union Carbide's Molecular Sieves 101 or 108 produce more total motor fuels than is possible from an exact Schulz-Flory distribution. A catalyst consisting of Union Carbide's Molecular Sieve 103 and a promoted metal component is extremely durable. The catalyst remained on stream for three months partially under very severe reaction conditions and showed no significant deactivation. These catalysts produce high total motor fuel yields due to the cutoff of high boiling hydrocarbons by the molecular sieve.

25615 (CONF-8310252—, pp 12.1-12.13) **Syngas conversion and chemisorption studies on metal-zeolite catalysts.** Rao, V.U.S.; Gormley, R.J.; Shamsi, A.; Schehl, R.R.; Obermyer, T. (Pittsburgh Energy Technology Center, Pittsburgh, PA; Pennsylvania State Univ., McKeesport, PA). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Cobalt-ZSM-5 and cobalt-thoria-ZSM-5 catalysts have been examined for synthesis gas conversion at 280°C. In the cobalt-ZSM-5 catalysts prepared by the impregnation of ZSM-5 with cobalt nitrate solution, it was shown by chemisorption and magnetization studies that the amount of cobalt that could not be reduced to metallic form in flowing H_2 at 350°C amounted to nearly 2 wt% of the catalyst, and evidently was ion-exchanged. Cobalt-ZSM-5 catalysts prepared via the physical admixture of precipitated cobalt oxide with ZSM-5 were also examined. In synthesis gas conversion and in ethylene conversion, the physically admixed catalysts showed a higher fractional yield of aromatics in the liquid hydrocarbon product than the solution-impregnated catalysts. Catalysts prepared by the impregnation of ZSM-5 with $C_5H_5Co(CO)_2$ and containing 3 wt% cobalt showed higher metal dispersion, higher H_2 + CO conversion, and about 10 times higher yield of gasoline range hydrocarbons (g/hr) than the catalysts with similar metal loading prepared by the other two methods. Addition of thoria as a promoter to cobalt-ZSM-5 caused a considerable increase in synthesis gas conversion and selectivity to gasoline-range hydrocarbons. Some Co-ThO_2-ZSM-5 catalysts provided, during the first 24-hour period of the test, nearly 65 wt% selectivity to gasoline-range product that contained 26 vol% aromatics (alklbenzenes). Addition of thoria resulted in the decrease of the cobalt crystallite size from about 40 nm to 10 nm, and caused an increase in CO/H adsorbed. The conversion of synthesis gas in a single stage metal-zeolite catalyst has been compared over that in a dual stage set-up with separated Fischer-Tropsch and zeolite catalysts.

25616 (CONF-8310252—, pp 12.14-12.43) **Zeolite-supported cobalt catalysts for the conversion of synthesis gas to hydrocarbon products.** Shamsi, A.; Rao, V.U.S.; Gormley, R.J.; Obermyer, R.T.; Schehl, R.R.; Stencel, J.M. (Pittsburgh Energy Technology Center, Pittsburgh, PA; Pennsylvania State Univ., McKeesport, PA). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Three differently prepared cobalt/ZSM-5 catalysts were investigated with respect to physical and chemical properties and to activity and selectivity for conversion of synthesis gas. The catalyst preparations consisted of the following: (1) direct decomposition of $C_5H_5Co(CO)_2$ on ZSM-5, (2) impregnation of ZSM-5 with an aqueous solution of cobalt nitrate, and (3) physical admixture of precipitated cobalt oxide with ZSM-5. The concentration of cobalt varied from 1.5 wt% to 9 wt%. At about 3 wt% cobalt loading, the first catalyst showed higher dispersion, higher (H_2 + CO) conversion, and about 10 times higher yield of gasoline-range hydrocarbons (g/hr) than the catalyst prepared by the other two methods. Some H_2 and CO chemisorption studies and magnetization measurements were conducted to measure the average particle diameter. The CO/H adsorption ratio is lower for the catalyst prepared from $C_5H_5Co(CO)_2$ than for the catalyst from the metal nitrate solution. This ratio increases with increasing metal dispersion. At low metal loading, the organometallic-impregnated catalyst has a higher degree of reduction and hydrogen uptake compared to the solution-impregnated catalyst. Infrared studies of chemisorbed pyridine on these samples indicate that ion exchange of CO^{2+} for acidic protons occurs in organometallic-impregnated and aqueous-solution-impregnated catalysts; however, the extent of ion exchange is greater for catalysts prepared by the latter technique. No ion exchange is found in physically admixed catalysts. In addition, the infrared data suggest that the organometallic preparation can cause blockage of the ZSM-5 channels unless appropriate activation procedures are followed. 19 references, 6 figures, 4 tables.

25617 (CONF-8310252—, pp 12.44-12.65) **Promotion and characterization of zeolitic catalysts used in the synthesis of hydrocarbons from syngas.** Rao, V.U.S.; Gormley, R.J.; Shamsi, A.; Schehl, R.R.; Obermyer, R.T.; Chi, R.D.H. (Pittsburgh Energy Technology Center, PA; Pennsylvania State Univ., McKeesport, PA). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Bifunctional metal-zeolite catalysts cobalt-ZSM-5 and cobalt-thoria-ZSM-5 were examined for the conversion of synthesis gas (H_2/CO = 1) at 280°C, 21 atm, and WHSV = 0.77 g/g cat. hr. The thoria in amounts as low as 0.4 wt% added to a cobalt-ZSM-5 with 9.0 wt% cobalt caused a considerable increase in synthesis gas conversion and selectivity to gasoline-range hydrocarbons. Some Co-ThO_2-ZSM-5 catalysts provided nearly 65 wt% selectivity to gasoline-range product that contained 26 vol% aromatics (alkylbenzenes). The selectivity to gasoline-range product exceeded the limit (48 wt%) set by Schulz-Flory kinetics. Chemisorption and magnetization studies were performed to determine metal particle size. Addition of thoria resulted in the decrease of the cobalt particle diameter from about 40 nm to 10 nm and caused an increase in CO/H adsorbed. The action of thoria as a promoter is possibly related to the presence of basic sites on its surface. 15 references, 3 figures, 3 tables.

25618 (CONF-8310252—, pp 13.1-13.13) **Spectroscopic studies of metal/zeolite catalysis materials and products.** Stencel, J.M. 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

The bifunctional catalysts Co/ZSM-5 and Fe/ZSM-5 are known to be capable of converting synthesis gas (CO + H_2) to a hydrocarbon product that has a carbon number cut-off at approximately C_{12}. The product selectivity in the C_5 to C_{12} range is dependent on catalyst preparation techniques, catalyst activation procedures, and reactor conditions. This paper discusses the effects of catalyst preparation on the product selectivity by investigating the acidity of the zeolite with infrared monitoring of chemisorbed pyridine. A formalism is developed to estimate the concentration of metal ions interior to the channels of the ZSM-5 and data are discussed relative to the determination of the oxidation state and association of this metal. In addition, preliminary results on the labile nature of the acidic protons in ZSM-5 will be presented. 2 figures, 2 tables.

25619 **(DOE/ID—10113) Biomass Alternative Fuels Program: results of the feasibility studies awarded under PL 96-126. Final report.** Stanley, N.E.; Wheeler, L.R.; Carpenter, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1983. Contract AC07-76ID01570. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011885.

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The Biomass Alternative Fuels Program was established by law and supplied government funding to 11 industrial organizations to perform feasibility studies on the production of alternative fuels from biomass feedstocks. This report presents a summary of the studies conducted under this program and a discussion of the accomplishments and impact of the program. The final reports from each of the 11 grant recipients were used as a basis for the information presented here. Each study included a discussion of feedstock availability, feedstock conversion technology, product uses or markets, environmental impacts, and project feasibility and profitability. In addition to a summary of each project, this report presents the results of the studies based on commonalities such as the source of feedstocks, conversion technologies, etc. Some common factors for feasible and infeasible projects are presented. The eleven projects investigated concerned the following processes: 5 projects on fluidized-bed gasification; 2 projects on carbonization; one project each on densification, degum soy oil, anaerobic digestion, and hydropyrolysis. Feedstocks were wood, rice hulls, manures, and soybeans.

25620 **(DOE/PC/50816—6) Metal boride catalysts for indirect liquefaction. Quarterly technical progress report, December 1, 1983-February 29, 1984.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 12 Apr 1984. Contract FG22-82PC50816. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010727.

During the sixth quarter four boron-promoted cobalt catalysts were prepared by a new boriding process using diborane gas as the boriding agent. These catalysts were characterized by chemical analysis, BET, H_2 chemisorption, and x-ray diffraction. Temperature-programmed desorption spectra of H_2 were obtained for a sodium-promoted cobalt boride and a sodium-promoted Co/SiO_2. Four cobalt catalysts (unsupported, boron-promoted, sodium-promoted, and doubly-promoted) were tested for CO hydrogenation activity and selectivity at 1 atm and 3 to 4 temperatures in the range of 190 to 240°C. About 10% of the surface of cobalt boride consists of reduced metallic cobalt. The addition of sodium to cobalt increases its binding energy with H_2 and its activation energy for H_2 adsorption. Boron does not affect the activity of cobalt; sodium decreases it by a factor of 10. Cobalt boride produces lighter hydrocarbon products relative to cobalt; sodium-promoted cobalt produces heavier products, more alcohols, and more CO_2. 29 references, 10 figures, 4 tables.

25621 (LBL—13500, pp 1.2-1.6) **Operation of the continuous bench-scale unit for direct liquefaction of biomass.** Figueroa, C.; Davis, H.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25622 (LBL—13500, pp 1.7-1.11) **Characterization of products from direct biomass liquefaction.** Schaleger, L.L.; Kloden, D.; Davis, H.G. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25623 (LBL—13500, pp 1.11-1.13) **Chemistry and mechanism of wood liquefaction.** Davis, H.G.; Schaleger, L.L.; Yaghoubzadeh, N. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25624 **Biomass conversion to liquid fuels: potential of some Arizona chaparral brush and tree species.** Davis, E.A. (Arizona State Univ., Tempe); Kuester, J.L.; Bagby, M.O. *Nature (London);* **307**: 726-728(23 Feb 1984). Contract AC02-76CS40202.

Arizona chaparral brush and tree species can be converted into high-grade liquid hydrocarbon fuels by indirect liquefaction in which pyrolysis is followed by catalytic liquefaction. Various Arizona chaparral species and other woody plants have been examined for oil and hydrocarbon content and as biomass feedstocks for pyrolytic conversion to high-grade liquid fuels. Although no tested species contained enough oils or hydrocarbons to be considered useful sources, gasification data show that they are all promising biomass feedstocks for pyrolytic conversion to liquid fuels. Olefin yield from biomass gasification, which is an indicator of liquid hydrocarbon yield, may be influenced by feedstock composition. If some particularly outstanding biomass feedstocks were discovered, then manipulation of the vegetation to favour those species could be a management alternative to prescribed burning or chemical control. Because most of the chaparral species tested produced pyrolysis gas of comparable olefin content, however, harvesting of chaparral without regard to species composition is indicated. 35 references, 1 table.

25625 **Study of the combustion of various alternate fuels.** Barfield, B.F.; Acker, G.J. Jr.; Lindsay, M.H. Tuscaloosa, AL; University of Alabama (1984). 112p. SOMED, Box 6282, Univ. of Alabama, Tuscaloosa, AL 35486.

This research project used two methods for studying the problems facing alternate fuels. The first method studied the use of chemicals to improve fuel characteristics without changing the basic engine design. The second method was to make engine modifications to suit characteristics of the alternate fuel. The result of the two methods studied is a two-part report. Alcohols, solvent-refined coal (SRC-II), vegetable oils, and mixtures of these with diesel fuels and with each other are the alternative fuels discussed and tested. 21 references, 4 figures, 10 tables.

25626 **Methanation of carbon dioxide on Ni(100) and the effects of surface modifiers.** Peebles, D.E. (Sandia National Lab., Albuquerque, NM); Goodman, D.W.; White, J.M. *Journal of Physical Chemistry;* **87**: No. 22, 4378-4387(27 Oct 1983). Contract AC04-76DP00789.

The methanation of CO_2 over Ni(100) was studied with H_2/CO_2 ratios of 4/1 and 96/1 (total pressures of 120 and 97 torr) for temperatures between 450 and 750 K. Large amounts of CO were formed, with activation energies of 21.2 and 17.4-19.7 kcal mol^{-1} for CH_4 and CO formation, respectively. The absolute CH_4 production rates were very close to those seen for methanation of CO. These results support a mechanism with CO and C(a) intermediates. Adsorption of K and/or S resulted in changes in the amounts and rates of CH_4 and CO production, but no change in activation energy. Results showed that the effects of K(a) can compensate for the effects of S(a), and support electronic interaction as responsible for poisoning/promotion effects. 9 figures, 2 tables.

25627 **Production of chemical feedstock by the methanolysis of wood.** Steinberg, M.; Fallon, P. (to Dept. of Energy). US Patent Application 6-500,101. 1 Jun 1983. 13p. Contract AC02-76CH00016.

A process is discussed for the production of ethylene, benzene and carbon monoxide from particulated biomass such as wood by reaction with methane at a temperature of from 700°C to 1200°C, at a pressure of from 20 psi to 100 psi for a period of from 0.2 to 10 seconds.

25628 **The flash methanolysis of wood for the production of fuels and chemicals.** Fallon, P.T.; Steinberg, M.; Sundaram, M.S. (Brookhaven National Laboratory, Upton, NY). pp 1171-1198 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—). Contract AC02-76CH00016.

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

Biomass in the form of less than 1000 micron oven dried fir wood particles was flash pyrolyzed in the presence of methane (methanolysis) in a downflow 1 in. I.D. tubular reactor at pressures of 20 to 200 psi and temperatures between 800° and 1050°C. The major products were benzene, toluene and xylene (BTX), a heavy oily liquid ($\geq C_6$), ethylene and carbon monoxide. As much as 12% of the available carbon in the wood was converted to BTX, 21% to ethylene and 48% to carbon monoxide at 50 psi and 1000°C. The maximum heavier oil yield of 11% was observed at 50 psi and 800°C. Wood particle residence times for all experiments were calculated to be less than 1 second at 20 and 50 psi and up to 2.8 sec at 200 psi. The yields were found to be greatly influenced by the methane to wood feed ratio. Experiments were conducted to insure the feed ratio. Experiments were conducted to insure the results to be that produced from the wood and methane and not a catalytic effect of the reactor wall or foreign matter. Material balance, including char analyses, indicate approximately 75 to 80% of the available carbon in the feed wood reacted. Methane balances were within the margin of error of the measuring equipment showing that there is no significant net production or consumption of methane.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 25625, 26263

25629 **(ANL/CNSV-TM—126) Energy from biomass: short-run economic effects of increased biomass production.** Shen, Sin-yan; Vyas, A.D. (Argonne National Lab., IL (USA)). Dec 1981. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84009386.

An agricultural policy-simulation model was modified to investigate the short-run (five-year) effects of increased biomass production on traditional agricultural activities under three scenarios. One scenario projected an annual production of one billion gallons of ethanol from corn at the end of a five-year period. The second scenario projected an annual production, on agricultural land, of wood equivalent in heating value to one billion gallons of ethanol. The third scenario projected an annual production of wood, also on agricultural land, equivalent in heating value to 10 billion gallons of ethanol. It was found that the impact on total consumer food costs of the third scenario is nearly twice that of the first scenario. 6 references, 22 figures, 11 tables.

25630 **(CONF-8310252—, pp 6.1-6.53) Liquid phase methanol update.** Brown, D.M.; Klosek, J. (Air Products and Chemicals, Inc., Allentown, PA). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Liquid Phase Methanol (LPMeOH) technology has the potential to be a lower-cost conversion route to methanol-from-coal than current gas-phase coal-derived synthesis gas rich in carbon monoxide because: it is capable of processing feed gas of varying CO and H_2 contents; it can achieve high CO conversion per pass; and it permits effective recovery of heat liberated during the reaction. A DOE-owned skid mounted process development unit was transferred from Chicago, refurbished and expanded for service. Synthesis feed gas from the facility will be used to test the unit beginning late this year. A liquid-fluidized (ebullated bed) mode and a liquid-entrained (slurry) mode will be tested. In the bench scale effort, new baseline data has been established for gas phase and liquid phase methanol synthesis. CO conversion and methanol specific productivity in the liquid phase are comparable to the gas phase at matching conditions. Optimum in-situ reduction conditions for slurry powders have been identified which give performance very similar to gas phase reduction. Several commercial catalyst powders achieve acceptable liquid phase performance. Of the 28 new slurry catalysts prepared in this program, 3 have recently advanced from gas phase to liquid phase screening. Autoclave life tests were initially affected by the trace contaminants iron catalysts. With strong guard measures in place, liquid phase life data from the autoclaves has been encouraging. CO-rich gas was run in the autoclave in excess of 1500 hours, and balanced gas in excess of 1000 hours.

25631 (CONF-8310252—, pp 10.1-10.21) **Status of the 100 bpd fluid bed methanol-to-gasoline project.** Gould, R.M. (Mobil Research and Development Corp., Paulsboro, NJ). 1983. NTIS, PC A18/MF A01.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (12 Oct 1983).

Evaluation of the fluid-bed Methanol-to-Gasoline (MTG) process is progressing smoothly in the 100 BPD pilot plant in West Germany. The project is being conducted jointly by Mobil Research and Development Corporation, Uhde GmbH, and Union Rheinische Braunkohlen Kraftstoff AG. The project is supported financially by the U.S. DOE and the German Government. Following a brief shakedown period, the plant was started up in December, 1982 at the URBK facility near Cologne. The plant has accumulated over 4,000 hours on stream at feed rates of up to 200 BPD methanol. The first operational phase of the project was completed as scheduled in September, 1983. Plant performance met or exceeded all design goals. Finished gasoline yields of 90 wt% of total hydrocarbons were achieved at base case conditions with complete methanol conversion. Gasoline octane was 95-96 Research clear. Preliminary tests indicate that product stability is excellent. Process sensitivity studies indicate the potential for increased yields and improved operation at the expense of product octane. Modifications are currently underway in preparation for the second phase of operation, to begin in January, 1984. 12 figures, 2 tables.

25632 **(DOE/R7/01134—T1) Farm-sized immobilized cell reactor for the conversion of biomass to ethanol. Final project report.** (SEE CODE- 9513994 KXL, Inc., St. Louis, MO (USA)). 1981. Contract FG47-80R701134. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84007860.

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An on-farm sized (small scale) immobilized cell reactor (I.C.R.) or continuous fermentor was developed that would convert an acid hydrolyzed grain (corn) fermentable mash to an ethanol solution. Although not within the scope of this project, it was necessary to develop a continuous high pressure dilute acid hydrolysis steam cooking unit and attending boiler, grain metering, milling, scalping, pumping, etc. equipment that produced the sterilized mash. A 20-gallon net capacity I.C.R. was operated with continuous flow at an average of 10 GPH of hydrolyzate (mash) and produced 1 GPH of ethanol from 0.5 BPH of corn. Although theoretical yields were not achieved, 2 gallon/BU ethanol yield is practical for a small scale (on-farm sized) operation and with improvements from fine-tuning the hydrolysis section and fermentor, yields of 90% of theoretical should be achieved.

25633 **(IEA/EAS—E3/81/3) Cost of liquid fuels from coal. Part III. Methanol and methanol-derived gasoline.** Hemming, D.F.; Holmes, J.M.; Teper, M. (International Energy Agency Coal Research, London (UK). Economic Assessment Service). Mar 1983. 116p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84901031.

This part of the study on the cost of liquid fuels from coal deals with the production of turbine-grade methanol, and of high-octane gasoline from methanol. In methanol production, coal is gasified, purified, adjusted in chemical composition and the resulting synthesis gas converted over a suitable catalyst. The crude methanol thus formed can be distilled to turbine-grade methanol or converted to gasoline using the Mobil MTG process. Production of these fuels using both dry-ash Lurgi and Texaco gasifiers is evaluated. The former gasifier involves either reforming of the methane produced to give additional synthesis gas or co-production as SNG. Coals considered are Illinois No. 6 and Wandoan (from Queensland, Australia), representing high-sulphur bituminous coal and low-sulphur sub-bituminous coal, respectively. The report concludes that neither methanol nor methanol-derived gasoline produced from coal currently competes with oil-based products if a commercial rate-of-return on equity is required. However, at low rates-of-return, methanol from imported hard coal or West German lignite approaches competitiveness. Methanol from coal is some 20 to 30% cheaper than methanol-derived gasoline. Whether such a differential is sufficient to encourage the use of methanol as an alternative transport fuel remains to be seen. 29 references, 8 figures, 9 tables.

25634 (LBL—13500, pp 1.14-1.19) **Ethanol production and recovery from biomass sugars.** Blanch, H.W.; Wilke, C.R.; Maiorella, B.L.; Murphy, T.K. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25635 (LBL—13500, pp 1.19-1.23) **Production of sugars from cellulose.** Wilke, C.R.; Blanch, H.W.; Dove, G.B.; Hendy, N.A.; Mancuso, A.; Orichowshyi, S.T.; Perez, J.M.; Sciamanna, A.F.; Wiley, D.F. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25636 (NP—4770238, pp 79-81) **Chemical raw materials from cellulose.** Wagner, F.; Chapotot, R.; Marschoun, S.; Rapp, P.; Rau, U.; Reng, H. 1983. (In German). Gesellschaft fuer Biotechnologische Forschung m.b.H., Braunschweig, Germany, F.R.

In GBF scientific report 1982.

Plant biomass contains lignin, cellulose and hemicelluloses. In recent years intensive efforts have been made to search for biotechnological applications for these polymers. Our studies relate to the development of a process for the hydrolysis of plant biomass with the aid of bacteria as well as the necessary prerequisites for such a process, such as knowledge of type, formation and regulation of hydrolases. The studies on utilization of products of hydrolysis have two separation aims: the conversion of these sugars into ethanol, and to a greater degree into polysaccharides of technical interest.

25637 **(UVA—527247/SEAS84/101) Schladitz whiskers as catalysts and catalyst supports applied to methanol synthesis.** Schladitz, H.J.; Vines, S. (Virginia Univ., Charlottesville (USA). Research Labs. for the Engineering Sciences). Dec 1983. Contract AC05-79ER10067. 342p. NTIS, PC A15/MF A01; GPO Dep. Order Number DE84011228.

Short-term tests indicated that a catalyst containing 10% copper plated iron whiskers gave a 4% enhancement in production of methanol per unit of reactor volume, although the whisker containing catalyst was 10% catalytically inert whiskers. Longer term tests indicated a lower rate of activity decay. A special series of tests indicated that the improved thermal conductivity of catalyst containing copper plated whiskers did result in a closer approach to equilibrium conversions. At 250°C a 10% whisker catalyst attained 93% of equilibrium while a non-whisker catalyst was 88%.

25638 **Synthesis of carbon-13 labeled aldehydes, carboxylic acids, and alcohols via organoborane chemistry.** Kabalka, G.W.; Delgado, M.C.; Kunda, U.S.; Kunda, S.A. (Univ. of Tennessee, Knoxville). *Chemical Engineering Science;* **49**: No. 1, 174-176(13 Jan 1984). Contract AS05-80EV10363.

The carbonylation of organoboranes using carbon-13 enriched carbon monoxide to produce labeled aldehydes in excellent yields is described. This same synthesis technique was tested for the production of labeled carboxylic acids with the incorporation of direct oxidation of the initial organoborane adduct; however, yields were not as good as those obtained with silver oxide oxidation of the aldehydes to produce acids. Since higher yields of carbon-13 labeled alcohols were obtained by reduction of the aldehyde with a borane reagent rather than the direct hydrolysis of the initially formed organoborane, the former method is recommended for the production of carbon-13 labeled alcohols.

25639 **Ruthenium complexes of 1,3-bis(2-pyridylimino)isoindolines as alcohol oxidation catalysts.** Gagne, R.R.; Marks, D.N. (California Inst. of Tech., Pasadena). *Inorganic Chemistry;* **23**: No. 1, 65-74(4 Jan 1984).

The ruthenium complex (1,3-bis(4-methyl-2-pyridylimino)isoindoline) trichlororuthenium III catalyzes the autoxidation and electrochemical oxidation of alcohols in basic solution. The reaction is general, resulting in the oxidation of primary and secondary alcohols, with the principal products being aldehydes and ketones. The catalytic autoxidation is affected by the

strength of the base used and its coordinating ability. The best results were obtained with sodium ethoxide as a base. Turnover numbers of 10-30 per day were observed in 1 atm of oxygen at ambient temperature, with larger turnover numbers at higher temperature. More than 200 turnovers were observed in the oxidation of ethanol at the ambient temperature with little or no loss of catalytic activity. The catalyzed electrochemical oxidation was carried out in an alcoholic solution containing 2,6-lutidine with a carbon electrode at 0.8-1.0 V vs. NHE. In the absence of catalyst, negligible current was observed. More than 20 catalytic cycles were completed with the current remaining at 75% of its initial value. The ruthenium III complex exhibits reversible one-electron oxidation waves in non-alcoholic solvents in the presence or absence of 2,6-lutidine. Possible pathways for the catalytic autoxidation and electrochemical oxidation are presented.

25640 **Method and system for producing lower alcohols.** Rathke, J.W.; Klingler, R.J.; Heiberger, J.J. (to Dept. of Energy). US Patent Application 6-535,463. 26 Sep 1983. 18p. Contract W-31-109-ENG-38.

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It is an object of the present invention to provide an improved catalyst for the reaction of carbon monoxide with water to produce methanol and other lower alcohols. It is a further object to provide a process for the production of methanol from carbon monoxide and water in which a relatively inexpensive catalyst permits the reaction at low pressures. It is also an object to provide a process for the production of methanol from carbon monoxide and water in which a relatively inexpensive catalyst permits the reaction at low pressures. It is also an object to provide a process for the production of methanol in which ethanol is also directly produced. It is another object to provide a process for the production of mixtures of methanol with ethanol and propanol from the reaction of carbon monoxide and water at moderate pressure with inexpensive catalysts. It is likewise an object to provide a system for the catalytic production of lower alcohols from the reaction of carbon monoxide and water at moderate pressure with inexpensive catalysts. In accordance with the present invention, a catalyst is provided for the reaction of carbon monoxide and water to produce lower alcohols. The catalyst includes a lead heteropolyatomic salt in mixture with a metal formate or a precursor to a metal formate.

25641 **Method and apparatus for synthesizing hydrocarbons.** Colmenares, C.A.; Somorjai, G.A.; Maj, J.J. (to Dept. of Energy). US Patent Application 6-506,560. 21 Jun 1983. 15p. Contract W-7405-ENG-48.

A method and apparatus for synthesizing a mixture of hydrocarbons having five carbons or less is disclosed. An equal molar ratio of CO and H_2 gases is caused to pass through a ThO_2 catalyst having a surface area of about 80 to 125 m^2/g. The catalyst further includes Na present as a substitutional cation in an amount of about 5 to 10 atom %. At a temperature of about 340 to 360°C, and at pressures of about 20 to 50 atm, CH_3OH is produced in an amount of about 90 wt % of the total hydrocarbon mixture, and comprised 1 mole % of the effluent gas.

25642 **Ethanol production method and system.** Chen, M.J.; Rathke, J.W. (to Dept. of Energy). US Patent Application 6-498,437. 26 May 1983. 19p. Contract W-31-109-ENG-38.

Ethanol is selectively produced from the reaction of methanol with carbon monoxide and hydrogen in the presence of a transition metal carbonyl catalyst. Methanol serves as a solvent and may be accompanied by a less volatile co-solvent. The solution includes the transition metal carbonyl catalysts and a basic metal salt such as an alkali metal or alkaline earth metal formate, carbonate or bicarbonate. A gas containing a high carbon monoxide to hydrogen ratio, as is present in a typical gasifer product, is contacted with the solution for the preferential production of ethanol with minimal water as a byproduct. Fractionation of the reaction solution provides substantially pure ethanol product and allows return of the catalysts for reuse.

25643 **Energy efficient alcohol fuel production.** Henry, R.D. (Illinois State Univ., Normal). pp 14-16 of Miami international conference on alternative energy sources. Vezirogla, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

25644 **Kentucky's new generation power alcohol distillery.** Wade, J.N.; Harvin, R.L.; Licht, S.E. (Kentucky Agricultural Energy Corporation, Franklin, Kentucky). pp 921-940 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—).

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

The development of the Kentucky Agricultural Energy Corporation 21 MM GPY power alcohol project from inception through planning, funding, design and construction is presented. The project was in the first group of DOE cooperative agreement awards and in the FmHA loan guarantee program. The services of an engineering contractor were essential in project scoping, technology evaluations and in preparing documents for submission to government agencies and financial institutions. The design was based on proven dry-milled corn technology with performance guarantees as required by the funding sources. To prevent early obsolescence, the design was energy efficient and adaptable to new technologies. The continuous cooking process uses minimum energy and the latest enzyme technology. The batch fermentation maintains high productivity with control of temperature and oxygen level. The alcohol dehydration uses a new efficient gasoline entrainer process. The 3-5% sulfur coal is desulfurized by limestone in two 60M Lb/Hr fluidized bed boilers which are among the first such industrial units commissioned.

25645 **FeTi methanation catalyst.** Lynch, J.R. (Brookhaven Natl. Lab. Assoc. Univ. Inc.); Spaulding, L.D.; Sapienza, R.S. *ACS Symposium Series;* **23**: No. 4, 1345-1349(Sep 1978).

A homogeneous intermetallic compound obtained by arc-melting equimolar amounts of the component metals, was tested after crushing and thorough hydriding, in a gas-cycling reactor at 250°-350°C and 15.3 atm on 20 mole '3< CO_2-H_2 and 33 mole '3< CO-H_2 reaction mixtures. Both CO_2 and CO were reduced by hydrogen at '3: 180°C via a catalytic process. The formation rate of methane, the main reaction product, from CO_2 was about ten times that observed in CO reduction. Both carbon oxides yielded small amounts ('3; 5'3<) of ethane; 2'3< methanol was produced in the reduction of CO_2 but not of CO. Apparently, greater amounts of methanol were originally formed from CO_2 but part of the alcohol interacted with the catalyst to form alkoxides, which then converted to CH_4 and CO. The reduction of CO_2 yielded also CO; its concentration, initially 10'3<, increased to a plateau value which was lower than the equilibrium CO concentration of the water gas shift reaction. Details of the catalyst activity and reaction mechanism were satisfactorily explained by the recently proposed Sapienza et al. "oxide theory" for Fischer-Tropsch and related processes.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 25272, 25629, 26234

25646 (ANL/CNSV-TM—127, pp 3-8) **High efficiency fuel utilization.** Wright, R.C. (Aqua-Chem, Inc., Milwaukee, WI). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The need for new energy supplies has resulted in the evolution of mill and forest wastes into a valuable resource. There are many ways to utilize wood fuel in boilers, but only one will be described here because of its unique properties. Suspension firing is an old, widely used burning method. Use of suspension burning has been limited by excessive particulate emissions and inability to fire many boilers designed for gas and oil. Fuel properties, furnace environment and burner design for wood-firing suspension burners are described.

25647 (ANL/CNSV-TM—127, pp 31-39) **Replenishable organic energy for the MMC (21st) century.** Holum, W.B. (Guaranty Performance Co., Inc., Independence, KS). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The feasibility of densification of fuels from residual biomass is currently being studied. This paper discusses the densification process, user experience and production costs. Burning refined, woodbased fuels in existing boilers allows immediate benefit to the operator by reduced emission of particulate that for stoker fired systems has demonstrated to be within state air quality limits. No costly conversion is required since existing stoker systems are used unchanged and pulverized coal systems require minimal change. The inconvenience of hog fuel or green wood chips mainly derives from material handling problems that result from a minimally specified fuel. Refined fuel pellets provide a convenient, uniform fuel which meets property limits specified by the fuel supply contract. Thus the operator may anticipate the fuel properties and burning characteristics.

25648 (ANL/CNSV-TM—127, pp 51-58) **Selecting a biomass boiler system.** Jacenko, R.J. (Richwood Co. of Detroit Lakes, Inc., MN). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The technology available and the cost involved in wood burning are discussed. There are three major elements to consider in the design of any combustion system. They are: (1) the fuel to be burned; (2) the combustion and handling equipment; and (3) the method of financing the project. The equipment briefly described includes stokers, pile burning, suspension burners, cyclone burners, fluidized-bed combustors, and gasifiers. (DMC)

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 26163

25649 **(DOE/NBM—4005845) Water over the dam: a small scale hydro workbook for Colorado.** (Colorado Office of Energy Conservation, Denver (USA); Colorado Dept. of Natural Resources, Denver (USA). Colorado Water Conservation Board). Jul 1981. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84005845.

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This manual is for individuals interested in developing small scale hydropower sites in Colorado. Although small scale hydro is sometimes defined as power production up to 80 megawatts, most developers using this handbook will have projects ranging from 10 kilowatts to 20 megawatts. No information is provided in this handbook about constructing new storage or diversion structures on the assumption that the sites to be developed involve existing dams or minor diversion projects. Topics covered include: who should develop the site, feasibility, water law, permits and licenses, environmental effects, sale and purchase of power, financing, taxation, and equipment selection and consumer protection. Included in appendices are: municipal options for public/private development of hydropower, engineering and manufacturing firms, hydropower, engineering and manufacturing firms, state permitting details, federal permitting details, examples of managed areas requiring consultation, agency contacts, Colorado utility jurisdictions, and recommended avoided cost rates for small power production and cogeneration sale of power to Colorado regulated utilities. (MHR)

1301 Resources And Availability

25650 **Federal study evaluates new hydro potential.** Hollander, E. *EPRI (Electric Power Research Institute) Journal;* 9: No. 2, 34-36(Mar 1984).

A comprehensive study by the US Army Corps of Engineers has identified candidate sites for hydroelectric power development to the year 2000. The sites are identified according to North American Electric Reliability Council regions. The project included a series of four screenings to identify (1) those projects with the physical potential for hydroelectric development, (2) projects capable of producing enough energy to repay generation equipment costs, (3) environmental impacts and their economic costs, and (4) near- and long-term projects. Nearly 2000 of the original 60,000 sites survived the fourth level of screening. 1 table.

1303 Plant Design And Operation

25651 **More power from hydro.** Lihach, N.; Birk, J.; Sullivan, C. *EPRI (Electric Power Research Institute) Journal;* 9: No. 2, 7-13(Mar 1984).

Utilities are striving to upgrade the already impressive performance of hydroelectric plants at a reasonable cost. The Electric Power Research Institute (EPRI) solicited utility industry feedback on what kinds of improvements to pursue, with forced outages, scheduled outages, plant efficiency, and new equipment reliability ranking as top candidates. Innovative approaches to operation and maintenance are springing up, but more effective channels for sharing technical information are neeeded. 7 references, 2 figures, 1 table.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 25603

25652 **(DOE/CS/30396—T1) International solar agreements. Final technical report.** (Orkand Corp., Silver Spring, MD (USA)). 1980. Contract AC01-80CS30396. 75p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84009622.

This document contains a summary of the International Market Development Program and updated status reports of the following IEA and bilateral agreements: Biomass Conversion; Forestry Energy; Large Scale Wind Energy Conversion Systems; Small Solar Power Agreements; Solar Heating and Cooling; Wave Power; Wind Energy Conversion Systems; U.S.-Israel; U.S.-Italy; U.S.-Mexico; U.S.-Saudi Arabia; and U.S.-Spain.

25653 **(NP—4900812) 1984 state solar directory.** (Solar Rating and Certification Corp., Washington, DC (USA)). 1984. 139p. SRCC, 1001 Conn. Ave., NW Suite 800, Washington, DC 20036.

The information contained in this publication is based on responses to a survey conducted by the Interstate Solar Coordination Council (ISCC) of the fifty states' solar programs. The directory is divided into three sections. The first section is a roster listing for each state'e energy office, consumer protection agency, education contact, research agency, ISCC delegate, citizens' solar group,and industry association as well as administering agencies for equipment certification, contractor licensing, grants and loans, and utility incentives. The second section lists each state's tax incentives available for solar, grant and loan programs, utility involvement in solar programs and each state's requirements for solar equipment certification and contractor licensing. The third section contains information on the programs offered by SRCC, national energy information sources, and ISCC Fact Sheets.

1401 Resources And Availability

25654 **(DOE/BP—190) Pacific Northwest solar radiation data.** (Oregon Univ., Eugene (USA). Solar Energy Center). 1 Apr 1984. 182p. NTIS, PC A09; 3; GPO Dep. Order Number DE84010328.

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This publication reports on the data gathered through December 31, 1983. Discussion of the data handling procedures and the accuracy of the data are included in the overview of the solar radiation in the Pacific Northwest at the beginning of this booklet. A summary of the data follows in the form of monthly averaged and long term hourly averaged tables for each site. A comprehensive listing of the daily data is given at the end of the book.

25655 **(DOE/R7/01227—T1) Assessment of solar blockage from tree canopies. Final report, September 30, 1981-December 30, 1982.** Youngberg, R.J. (Nebraska Univ., Lincoln (USA). Solar Resource Development Office). 1982. Contract FG47-81R701227. 189p. NTIS, PC A09; 3; GPO Dep. Order Number DE84009768.

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The purpose of this project is to provide data on the shading affect during summer and winter, of various trees commonly used in the midwest. A nomograph was developed from measurements of solar radiation penetration through the canopy of various deciduous tree species taken throughout the year. Six sites were selected which contain mature, healthy trees of selected species. These species were selected for their widespread use in windbreaks, as shade trees and for aesthetic reasons. These trees were selected for their uniformity in age and size, and their accessibility on publically owned land. The six trees selected are as follows: (1) Locust, (2) Silver Maple, (3) Red Oak, (4) Elm, (5) Cotton Wood, and (6) Sycamore.

25656 (LBL—13500, pp 2.20-2.23) **Measurement and anlaysis of circumsolar radiation.** Grether, D.F.; Evans, D.B.; Hunt, A.J.; Kanzler, S.G.; Harms, M.; Wahlig, M.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

25657 **(LBL—16425) Daylight availability as a function of atmospheric conditions.** Ne'eman, E.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 8p. (CONF-831069—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007973.

From 5. conference on atmospheric radiation; Baltimore, MD, USA (31 Oct 1983).

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This paper reviews the differences between thermal and daylighting considerations for building design and their implications for using illuminance and irradiance data. Old and new mathematical models for luminance distribution and illuminance calculation are explained. Overcast, clear, and average sky conditions are discussed and their dependence on atmospheric factors is examined. The focus is on the turbidity of the clear atmosphere and the luminance at the zenith. It is concluded that more measured daylighting data are required for validating the equations that have been developed separately in various parts of the world.

25658 **(SERI/TR—215-2046) Preliminary comparison of insolation measurements, forecasts, and estimates from satellite imagery.** Riordan, C.J. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1984. Contract AC02-83CH10093. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84004435.

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Two national insolation data products recently initiated by the National Oceanic and Atmospheric Administration (NOAA) are examined and compared with ground measurements. The products are the National Weather Service (NWS) insolation forecasts and the National Environmental Satellite Data and Information Service (NESDIS) satellite estimates of insolation. All insolation data were converted to daily global horizontal insolation in units of kWh m^{-2} and divided by extraterrestrial radiation on a horizontal surface to yield atmospheric transmittance. The mean absolute difference in transmittance between ground measurements and the NOAA estimates ranged from .087 to 0.135 for the limited data set. Recommendations are: (1) to evaluate recent improvements to the NESDIS algorithm; (2) to define criteria for evaluation of the products with respect to purposes and specific applications; and (3) to perform expanded evaluations and refine algorithms if necessary.

25659 **(SERI/TR—254-1687) Sunlight probability data for select cities in the United States.** Robbins, C.L.; Hunter, K.C. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1983. Contract AC02-83CH10093. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84000006.

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Sunlight probability data are useful in the design and analysis of daylighting systems since many systems perform differently under clear or overcast sky conditions. Sunlight probability is measured at many of the weather stations in the Typical Meteorological Year (TMY) and Estimated Typical Meteorological Year (ETMY) networks. The weather service makes this data available in the form of monthly and annual average percent sun. However, for many design situations, hourly sunlight probability data rather than monthly and annual averages are needed. This report presents a model that was developed to establish the computed probability of having sunlight in a given hour or for a specific duration of time for select cities in the United States.

25660 **Mapping sky and surface luminance distribution using a flux mapper.** Robbins, C.L.; Hunter, K.C. (Solar Energy Research Branch, Golden, CO). pp 74-75 of 5th Miami international conference on alternative energy sources. Vezirogla, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

25661 **Predicting daylight under a natural sky versus an artificial sky.** Hunter, K.C.; Robbins, C.L. (Solar Energy Research Inst., Golden, CO). pp 76 of 5th Miami international conference on alternative energy sources. Vezirogla, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

25662 **The stochastic sun: Understanding the intermittent resource.** Boyd, D.A. (Institute for Energy Analysis, Oak Ridge Associated Universities, Oak Ridge, Tennessee). *Alternative Energy Sources;* 1: 3-25(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Intermittency represents the essential difference between an energy flux resource such as solar energy, whose incidence is beyond the user's control, and the stored energy resource of fuels. The stochastic or random character of solar variability accounts for much of the uncertainty, even controversy, about utilization and cost of the sun's energy. Present assessments of the solar resource account for intermittency only in its effect upon average value of incidence at a given location. Other research has emphasized enlarging the network of sites at which solar data are available and increasing the size and accuracy of the data base; however, there is still a gap between available data and the data requirements of users, especially for systems involving storage. This paper discusses the concept of an ideal system as a device for determining the usable solar resource. The ideal system is defined in terms of a loss-free collector area and storage capacity per unit of system demand. The portion of incident energy (termed "recoverable resource") delivered by the ideal system represents an upper bound on the performance of any corresponding real system at the same location. The recoverable resource is shown to vary consistently with ideal system size in many diverse locations; implications for collecting solar resource data are discussed. Distributions of frequency, duration, and severity of resource deficiencies are illustrated; rare but lengthy shortfall occurrences comprise a surprisingly large portion of total resource shortfall. Total costs of using solar energy include possible costs of having reduced energy supply during worst-case solar deficiencies as well as capital and fuel costs. Lower limits to these costs can be assessed easily using the ideal system and recoverable resource concepts.

1403 Economics

REFER ALSO TO CITATION(S) 26166

25663 **(DOE/ET/23198—T1) Market analysis of the solar energy industry.** (Solar Energy Industries Association, Washington, DC (USA)). Aug 1979. Contract AC01-80ET23198. 68p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84009463.

This report describes the results of a survey of companies in the solar energy industry. The general objective of the survey was to provide information to help evaluate the effectiveness of technology transfer mechanisms for the development of the solar industry. The specific objectives of the survey included: (1) determination of the needs of the solar industry; (2) identification of special concerns of the solar industry; and (3) determination of the types of technology transfer mechanisms that would be most helpful to the solar industry in addressing these needs and concerns. The major focus was on technical problems and developments, but institutional and marketing considerations were also treated. The majority of the sample was devoted to the solar heating and cooling (SHAC) component of the industry. However, a small number of photovoltaic (PV), wind, and power generation system manufacturers were also surveyed. Part I discusses the methodology used in the selection, performance, and data reduction stages of the survey, comments on the nature of the responses, and describes the conclusions drawn from the survey. The latter include both general conclusions concerning the entire solar industry, and specific conclusions concerning component groups, such as manufacturers, architects, installers, or dealers. Part II consists of tabulated responses and non-attributed verbatim comments that summarize and illustrate the survey results.

25664 **(DOE/RG/06405—T1) Case studies on impacts of rate design on dispersed solar energy systems. Task 1. Literature review and survey of utility rates.** Phillips, B. (ICF, Inc., Washington, DC (USA)). 1 Mar 1979. Contract AC01-78RG06405. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84009513.

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The principal purposes of the study are to: analyze the impacts of alternative rate designs for auxiliary electricity on the design, operation, and cost-effectiveness of active solar space and water heating systems to customers; analyze the impacts which the demands for auxiliary electricity may have on utility costs, revenues, and operating characteristics; study the interaction of these impacts within a regulatory environment; and prepare a set of practical guidelines which will assist regulatory authorities and utilities in the consideration, design, and possible implementation of rates for solar auxiliary power. As initial tasks, (1) a review and evaluation of several published studies which address issues concerning the solar/utility interface have been conducted, and (2) all utilities which have implemented electric rates which explicitly apply to the purchase of auxiliary electricity by solar owners have been identified. The findings of these tasks are presented in this report. Electric rate design is the primary focus of our study. Therefore, our literature review focuses on works which examine solar auxiliary rate designs and closely related issues such as the costs to utilities to serve solar customers. Nine studies are reviewed in detail. A brief description of each study is presented. A bibliography of selected works which directly address solar/utility interface issues is attached as an appendix.

25665 **(DOE/RG/06405—T4) New Mexico residential solar rate initiatives. Executive summary and rulemaking document.** (ICF, Inc., Washington, DC (USA)). Dec 1980. Contract AC01-78RG06405. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010374.

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The purpose of this study is to provide information and to develop analytical procedures related to electric utility rate design and commercialization of residential solar heating systems. The focus has been on factors - principally related to rate design - which can be affected directly by the New Mexico Public Service Commission (PSC) through formal rulemaking or through policies and procedures established in the rate design process. Our overall approach has been to review previous studies on these issues, to present methodologies for analyzing them, and to develop analytical results using New Mexico-specific data. The purposes of this volume are to offer recommendations based on the findings of the project, to summarize the work detailed in the three reports, and to present a general framework for use by the PSC in considering solar rate design. Each of these is addressed in turn in the remainder of this document.

25666 **(FRNC-TH—1265) Technical, economical and energetic optimization of thermic systems.** Giulietti, M. (Institut National Polytechnique, 54 - Nancy (France)). Jun 1982. 192p. (In French). NTIS (US Sales Only), PC A09; 03. Order Number DE84751357.

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The technical, economical and energy optimizations of some thermic systems are given: a monotubular heat exchanger, preheater of boiler supply water; a liquid-liquid calender tubular heat exchanger without phase changes; a separator-condenser-evaporator of a lithium bromide aqueous solution; a concentric pipe heat exchanger and a daily storage solar heating system. Technical, monetary and energetic objective functions have been established; optimum obtained with the Energy-Cost Characteristic (Caracteristique Energie-Cout: CAREC) diagram have been compared in determining the different overcost and undercost when passing from one optimum to another.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 26166, 27051

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 25272, 25589, 25590, 25591, 25592, 25593, 25594, 25595, 25596, 25597, 25598, 25604, 25619, 25621, 25622, 25623, 25624, 25627, 25628, 25629, 25632, 25634, 25635, 25636, 25643, 25644, 25646, 25648, 26234, 26263, 26362, 26526, 26553, 26554, 26555, 26556, 27086, 27101, 27104, 27221

25667 (ANL/CNSV-TM—127, pp 17-24) **Thermochemical conversion of biomass: perspectives of prospective users.** Bond, D. (Desmond Bond, Inc., Vienna, VA). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

Biomass energy is not being as extensively derived or applied as had been hoped for. The primary reason is not shortage of biomass, not unavailability of commercial biomass-to-energy conversion processes, but reluctance on the part of the potential users. Naturally, this disinclination is based on economics, the various features of which have direct and indirect effect on each user's cost function. Contacts with current and prospective users of biomass energy, with vendors of thermochemical conversion equipment, and with consultants in the field have provided information on the lack of enthusiasm for application of this category of alternative fuels. These perspectives are documented. Suggestions are offered for promotion of commercial thermochemical conversion of biomass to energy.

25668 (ANL/CNSV-TM—127, pp 25-30) **Silviculture - energy's future.** Dula, J.C. (American-Canadian Poplar Growing Association, Canby, OR). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The American-Canadian Poplar Growing Association (herein referred to as A-C) believes Silviculture can become one of this nation's greatest assets and will be of endless duration. To that end, it has expended considerable time, effort and money to develop and produce tree root stock that can be grown and utilized world-wide for the production of energy, food and fibre products. It is also the intent of A-C to share the results of its endeavours with others in the hope that such cooperation and participation will benefit all, and goals and needs of the future can be met. For this purpose, an energy form is identified as a place that will produce a

raw material on a yearly basis, without replanting each spring, for the production of energy or other biomass needs. It has been established that the wood grass method of planting can produce high tonnage on less acres and should become more feasible and economical with the development of specialized machinery.

25669 (ANL/CNSV-TM—127, pp 41-50) **Integrated agricultural fuel systems.** Houston, R.K. (Agrecology, Inc., Kansas City, MO). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

A production/harvest program is described. It is probably impossible to finance or execute on a machine for sale basis. Agrecology, Inc. plans to profit, with others, from the service the machine performs and the product it harvests. This will necessitate subcontracting of machine operations and local, profit motivated management. It will require a great deal of working together - of technology licensing inventors, financeers, promoters, managers, agronomists, engineers, bacteriologists, farmers, etcetera. The cast of necessary participants is broad indeed. The Agrecology production/harvest system is executed by a self propelled, 30 foot wide, folding, multi-functional, high capacity machine that simultaneously tills, harvests and separates leaves from stalks and then densifies the harvested material into a self storing, moveable module. 6 references, 4 figures, 1 table.

25670 (ANL/CNSV-TM—127, pp 61-64) **Harvesting biomass fuels.** Keenan, D. (Morbark Industries, Inc., Winn, MI). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The technological advances in the harvesting of low grade timber must be matched by a marked change in our forest management practices. This presentation covers both important areas. The plan is based on timber stand improvement practices well known and understood by foresters but never achieved the proper level of acceptance due to the high cost of implementing such a plan. The prohibitive cost was brought about by the high cost of labor needed to implement timber stand improvement recommendations, now also called environmental thinning. The plan is amazingly simple. The forest land is managed like a garden, clearing out the weeds and selecting the species that will respond the best and/or produce best return. As positive and as simple as the plan is, three major road blocks must be overcome in the areas of: technology, markets and education. These areas are discussed briefly. It is concluded that environmental thinning is an upgrading of our forests and harvesting biomass for energy is a critical component of the process. Neither will reach its potential without the other. New technology is being developed and implemented. What the industry and government need to do is get involved more in the acceptance of wood fuel through marketing and educational programs and foster the development of increased future markets through R & D in liquid fuels, cattle feed and other uses of low grade fiber.

25671 **(BMFT-FB-T—83-238) Development and prototype production of photovoltaic energy supply systems.** Cordes, V.; Neuhaeusser, G.; Wegmann, H.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 242p. (In German). NTIS (US Sales Only), PC A11 MF/A01. Order Number DE84750922.

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The experimental study (BMFT FB T 79-143) had shown essential possibilities for cost reduction of photovoltaic power supply systems which could open up a larger field of application. This had been the reason for the definition of an 8-year-program. Its first phase is finished. The following development activities have been carried out: replacement of single crystalline by multicrystalline silicon, development of production processes for solar cells and solar generators using low-cost alternative materials; development and construction of experimental production lines with larger capacity for optimization of processes and production of higher quantities of prototype solar cells and solar generators. Development and production of power conditioning equipment, design of complete photovoltaic energy supply systems and test of all components in world-wide field tests. It has been proven that by realizing these development steps the production costs could be decreased by the factor of 10. Encouraged by this success a follow-on program has been planned which gives rise to expecting further important cost reductions for photovoltaic power supply systems.

25672 **(DOE/CE—0072) Five year research plan, 1984-1988. Photovoltaics: electricity from sunlight. National Photovoltaics Program.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Photovoltaic Energy Technology Div.). May 1983. 35p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010679.

Consistent with national energy policy guidance, the plan concentrates on photovoltaic research and development and limits system experiments to only those necessary to stimulate industrial confidence in the validity of research findings. A key strategy element is the continuation of the informal government/industry partnership which is critical to successful development of photovoltaic technology. The primary research emphasis is the development of promising new approaches to photovoltaic cells such as thin film and multi-junction concepts. Emphasis is also placed on completing the development of flat plate silicon designs which yield improved conversion efficiencies and are amenable to automated production. Other research areas include the development of improved array fields, power conditioners, and concentrator collectors.

25673 **(DOE/CS/84006—T1) Fuels from woody biomass. Final technical report, June 1, 1978-May 31, 1981.** Frederick, D.J.; Kellison, R.C.; Gardner, W.E. (North Carolina State Univ., Raleigh (USA). School of Forest Resources). 31 May 1981. Contract FG01-78CS84006. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011596.

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Species selection and silvicultural systems have been investigated for producing fuels from wood biomass in the southeastern United States. Four specific goals identified in development of this project include (1) summarizing existing species-site relationships and determining nutrient levels in trees and soils; (2) screening tree species and sources for suitability to intensive short-rotation biomass production; (3) determining optimum plantation management levels for the most promising species and quantifying biomass yields; and (4) employing genetic selection and breeding programs in location and development of trees for fuel production. Progress to date includes summarization of existing species-site trials, refinement of foliar sampling techniques, relation of foliar nutrient levels to soil fertility, development of estimates and prediction equations for tree and component nutrient contents, early evaluation of Alnus sources, and establishment of several species-site trials including indigenous tree species, shrubby weed species, ornamentals and exotics. Progress in energy plantation management has included establishment on several different sites, of installations with multiple species and spacings arranged that blocks may be harvested at different rotation ages. Also, preliminary evaluations have been made of biomass yields, nutrient contents and distribution, and caloric contents. Continuing and needed research involves maintenace and evaluation of established studies, application of destructive sampling (harvesting) at alternative ages, coppice management factors, nutrient uptake impacts, refinement of site evaluation, application of genetic solution, heritability and breeding program to energy production, and evaluation of natural stands on similar sites.

25674 **(DOE/JPL/955902—83/11) Process research on polycrystalline silicon material. Final technical report.** Culik, J.S. (Solarex Corp., Rockville, MD (USA)). 1984. Contract NAS-7-100-955902. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84011716.

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The performance-limiting mechanism in large-grain polycrystalline silicon solar cells were investigated by fabricating a matrix of 4 cm^2 solar cells of various thicknesses from 10 cm x 10 cm polycrystalline silicon wafers of several bulk resistivities. The analysis of the illuminated I-V characteristics of the cells of this thickness-resistivity matrix strongly suggest that bulk recombination is the dominant factor limiting the short-circuit current in large-grain polycrystalline silicon, the same mechanism that limits the short-circuit current in single-crystal silicon. Further investigation of the performance-limiting mechanisms consisted of fabricating a

set of mini-cell wafers from a selection of 10 cm x 10 cm polycrystalline silicon wafers. A mini-cell wafer contains an array of small (approximately 0.2 cm^2 in area) photodiodes that are isolated from one another by a mesa structure. The average short-circuit current on different wafers was 3 to 14% lower than that of single-crystal Czochralski silicon. The average open-circuit voltage was 20 to 60 mV less than that of single-crystal silicon. The fill-factor of both polycrystalline and single-crystal silicon cells was equivalent. Lower average values of open-circuit voltage and a greater degree of open-circuit voltage and fill-factor scatter were correlated with the presence of inclusions, which was also correlated with significantly greater values of shunt conductance. Measurement of the dark I-V characteristics of mini-cells from several wafers with few inclusions indicates that spatial variations in quasi-neutral recombination current are the dominant cause of open-circuit voltage variations. A damage-gettering heat-treatment was investigated and was found to improve the minority-carrier diffusion length in low lifetime polycrystalline silicon. However, extended high temperature heat-treatment did not further improve, but rather degraded, the lifetime.

25675 **(DOE/JPL/956254—2) Diodes in photovoltaic modules and arrays. Final report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). 15 Mar 1984. Contract NAS-7-100-956254. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010981.

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The use of diodes to enhance the energy generation capability and improve the reliability of photovoltaic modules and arrays is the subject of this final report. Beginning with a discussion of the array-level considerations influencing the application of such diodes in a bypass mode, the report continues further to describe several methods for the mechanical and electrical integration of these devices as an integral part of the module electrical termination means. Particular emphasis is placed on the description of innovative approaches for the external mounting of bypass diodes. These descriptions were used as the basis for a detailed cost analysis and comparison among the candidate concepts. The photovoltaic source circuit blocking or isolation function can be implemented using the same basic diode enclosure designs with provisions for the inclusion of a fuse for overcurrent protection.

25676 **(DOE/JPL/956616—83/2) Process research of non-CZ silicon material. Quarterly report No. 2, January 1, 1984-March 31, 1984.** Campbell, R.B. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). May 1984. Contract NAS-7-100-956616. 22p. (WAESD-TR—84-0013). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011548.

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In this program, which started November 4, 1983, the fabrication of solar cells on N-base material using simultaneous diffusion of liquid boron and phosphorus dopants to from the desired P^+NN^+ cell structure is being studied. This simultaneous junction formation method is being compared to the sequential junction formation method where phosphorus is diffused to form an N^+N back surface field followed by a boron diffusion for the P^+N front junction. During the contract, the sensitivity of the process parameters will also be studied; and a cost analysis of the new junction formation process will be performed using SAMICS-IPEG methodology.

25677 **(EUR—8156-FR) Optimisation of concentrating array of silicon solar cells.** Belluque, J.; Michel, J. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1982. 27p. (In French). Commission of the European Communities, Luxembourg.

The formation of a concentrator array of photovoltaic silicon solar cells is discussed, based on different studies concerning the concentrator optics, the silicon photocells, and the refrigerator system. As a result, the initial assumptions for the concentrator can be verified, and a very good performance seems to be possible up to a power concentration of 2.3 W/cm^2, it would be desirable to further push this value to 4.5 W/cm^2; there is no a priori reason which contradicts the operation at such energy density levels. In every case, all the efforts made to optimize the concentrator have been very disappointing due to technological limitations. It would not be reasonable to intend an industrial development of such a system. The essential useful results of this study are in the field of cell technology which can offer satisfactory solutions to all needs of medium concentrators.

25678 **(EUR—8327-FR) Industrial technology for economic and reliable encapsulation of large surface arrays of solar cells.** Anguet, J.; Salles, Y. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1983. 17p. (In French). Commission of the European Communities, Luxembourg.

Different approaches are described showing, that the technology of sheet glass, which is applied in the fields of civil construction and automobile industry, can be used for the incapsulation of solar cell arrays after some modifications. The behaviour of such pannels during environmental tests is satisfactory and this technology allows to assure a good stability in the electric performance. The results obtained in the course of this contract allow to start up with the final step, that is the investigation and the realisation of the necessary means for the production of sheet glas based solar pannels.

25679 **(FRNC-TH—1397) Characterization of Si solar cells.** Zolimiti, M. (Montpellier-1 Univ., 34 (France)). Jun 1982. 97p. (In French). NTIS (US Sales Only), PC A05; 03. Order Number DE84751352.

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A description of the structure of a $8cm^2$ silicon solar cell with a p-n junction is given. Measurements of I=f(V), C=f(V) and Z=f(I) in darkness are carried out. The characteristics of the cell are studied under illumination. The noise characteristics are presented.

25680 **(FRNC-TH—1399) Contribution to the study of solar cells. ITO/InP p cells.** Achiar, O. (Montpellier-1 Univ., 34 (France)). Jun 1982. 128p. (In French). NTIS (US Sales Only), PC A07; 03. Order Number DE84751353.

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The properties of the materials ITO and InP making up the diode are presented. A description of the method of manufacture is given. Then, the interface is characterized. The current-voltage characteristics in darkness are studied, as also the capacities, photovoltaic properties and spectral responses of these photodiodes. Finally, a comparison of Au/InP Schottky diodes with ITO/InP diodes prepared on the same InP substrate is made.

25681 **(FRNC-TH—1400) Contribution to the manufacture and the study of photovoltaic mechanisms of Cu2S-Cdsub(1-y)Znsub(y)S (0<=y<=0,15) solar cells prepared by aerosol pyrolysis ("spray").** Kaka, M. (Montpellier-1 Univ., 34 (France)). Jul 1982. 179p. (In French). NTIS (US Sales Only), PC A09; 03. Order Number DE84751354.

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The different properties of Cdsub(1-y)Znsub(y)S and Cusub(x)S prepared by different methods are reviewed. Then, the characterization of the two elements making up the cell is presented: characterization of CdZnS layers, and, optical properties of Cusub(x)S. The components in the manufacture of the complete cell and the photoelectric characterization of the cell are studied.

25682 **(N—8410662) High efficiency, low cost thin GaAs solar cells.** Fan, J.C.C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Sep 1982. 43p. (NASA-CR—168265). NTIS, PC A03/MF A01.

The feasibility of fabricating space-resistant, high efficiency, light-weight, low-cost GaAs shallow-homojunction solar cells for space application is demonstrated. This program addressed the optimal preparation of ultrathin GaAs single-crystal layers by AsCl3-

GaAs-H2 and OMCVD process. Considerable progress has been made in both areas. Detailed studies on the AsCl3 process showed high-quality GaAs thin layers can be routinely grown. Later overgrowth of GaAs by OMCVD has been also observed and thin FaAs films were obtained from this process.

25683 **(N—8411590) Amorphous silicon solar cells. Final Report, Mar. 1981.** Juergens, W.; Kruehler, W.; Moeller, M.; Pfleiderer, H.; Plaettner, R.; Rauscher, B.; Stetter, W. (Siemens A.G., Muenchen (Germany, F.R.)). Jun 1983. 192p. (In German). (BMFT-FB-T—83-112). NTIS, PC A09/MF A01.

A technique for manufacturing amorphous silicon solar cells is described. Hydrogenated amorphous silicon (a-Si:H) with excellent photoconductivity (ratio of photo and dark conductivity 10,000 for 0,25 mW/sqcm light intensity) photoluminescence, and low density of states was manufactured. Doping behavior in a-Si:H-films and dependence of geometrical cell structure on electrical properties were investigated. A-Si:H-Schottky barrier cells with Pt, Pd, Au and Ni as Schottky-contacts and pin/indium-tin-oxide cells were manufactured and investigated. With pin structure a conversion efficiency of 6,7% was achieved (Ante meridien (AM1) illumination, 6 sqmm active area). For larger solar cells (2,75 sqcm) efficiencies up to 5,9% were reached. Open circuit voltage, short circuit current and fill factor are 860 mV, 14,7 mA/sqcm and 64% respectively. Fluorinated and chlorinated a-Si:H and microcrystalline Si-material were investigated, and theoretical models are developed to explain the stationary and temporal photoluminescence and the behavior of the pin-cells.

25684 **(SAND—83-2014C) Thermal modeling of residential photovoltaic arrays.** Fuentes, M.K. (Sandia National Labs., Albuquerque, NM (USA)). 1 May 1984. Contract AC04-76DP00789. 7p. (CONF-840561—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011194.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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To better predict and evaluate the thermal behavior of photovoltaic arrays, a study has been initiated to predict the operating cell temperatures of various systems existing today. This effort is complete on five prototypes at the Southwest Residential Experiment Station (SWRES). These prototypes encompass the widest range of residential photovoltaic designs, and their temperature responses have been modeled to near the tolerance error of the measuring instruments. The arrays include a direct mount, rack mount, integral mount, and two standoff mounts. This study has concluded that the thermal response of the integral, standoff, and rack mounting designs of the Tri-Solar, BDM, and TEA prototypes are thermally equivalent. Furthermore, the direct mount of the GE prototype operates 14° to 18°C hotter than the others. Otherwise, the rest of the thermal difference between the prototypes is a result of the different module designs.

25685 **(SAND—83-2033C) PV concentrator structure and array test results.** Maish, A.B. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840561—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010932.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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As part of the photovoltaic (PV) concentrator research effort, tests are performed by Sandia National Laboratories on PV concentrator array systems and components in order to assess their performance and reliability. This paper discusses life tests which evaluate performance of full array systems over time in a real world environment. Tests performed on major array components which include the tracker/controller, structure and drive are also discussed. Test results are presented for first generation arrays and some second generation arrays. A summary of findings and their implications for future array designs is given.

25686 **(SAND—84-0243C) Photovoltaic concentrators: performance and reliability data and future design directions.** Edenburn, M.W.; Boes, E.C. (Sandia National Labs., Albuquerque, NM (USA)). 1 May 1984. Contract AC04-76DP00789. 10p. (CONF-840561—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011190.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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This paper will summarize the status and discuss likely future directions of photovoltaic concentrator technology. A current commercial Si cell module has a peak efficiency of 15.5%, and 17% has been reached for an experimental module. Advanced cells and module design improvements offer still higher efficiencies. Concentrator Fresnel lens array fields installed several years ago have all demonstrated very good electrical performance with little performance degradation. Fresnel lens arrays are commercially available and prices of $7/watt for installed one megawatt systems have been quoted. Cost projections predict that current technology concentrating PV arrays can be installed for less than $2/watt if they are manufactured in large, steady quantities. More advanced designs may cost even less.

25687 **(SAND—84-0963C) Installation, cost, and performance testing of a 30 kW photovoltaic array field based on a low cost modular design.** Noel, G.T.; Carmichael, D.C.; Alexander, G.; Post, H.N. (Battelle Columbus Labs., OH (USA); Sandia National Labs., Albuquerque, NM (USA)). 1 May 1984. Contract AC04-76DP00789. 8p. (CONF-840561—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011192.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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A modular building block design was developed in a preceding study which significantly reduces the balance-of-system (BOS) and site specific design costs associated with the installation of ground-mounted flat-panel photovoltaic array fields. The installation of a test-bed array field consisting of three of the building blocks (nominally 10 kW per building block) is discussed in this paper. The objective of the work reported herein is to demonstrate the cost effectiveness and the technical attributes of the low-cost modular building block design. The actual cost of the first-time installation was $134.15 (in 1982 dollars) per square meter of array aperture. The cost of a second-time installation of the three-building-block array field is estimated to be $78.38/m^2. Array field performance has been consistent with the design goals.

25688 **(SERI/STR—211-2230) Chemical vapor deposition of amorphous semiconductor films. Semiannual report, 1 May 1983-31 October 1984.** (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Mar 1984. Contract AC02-83CH10093. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84004489.

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This report presents an analysis of intrinsic and phosphorus-doped n-type amorphous silicon films deposited by LPCVD from disilane in a laminar flow tubular reactor. These films were analyzed using SIMs, ESR measurements, optical absorption, and conductivity in light and dark. CVD deposited i layers were used to make platinum Schottky barrier devices and hybrid cells utilizing glow discharge deposited layers in both the ITO/nip/Mo and ITO/pin/Mo configurations. The highest efficiency of hybrid cells with the ITO/ni(CVD)/p(GD)/Mo structure was approximately 1.5%. The highest efficiencies were obtained with thin i layers. The highest efficiency for the ITO/p(GD)/in(CVD)/Mo configuration was 4.0%. A chemical model was developed describing the gas phase reactions and film growth; the model quantitatively describes the effluent composition when the measured growth rate is input. Kinetic rate expressions and constants for growth from higher silanes are being determined for a wide range of reaction conditions.

25689 **(SERI/STR—211-2232) Development of stable high-efficiency polycrystalline thin film solar cells based on $CuInSe_2$.** Birkmire, R.W.; Hall, R.B.; Phillips, J.E.; Meakin, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84004484.

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$CuInSe_2$/CdS cells have been made with a variety of back contacts and with single and double layers of $CuInSe_2$. An improvement in fill factor and open circuit voltage was achieved by using a Mo/Pt back contact. Subsequently it was shown that the same performance could be obtained by lowering the substrate temperature during the $CuInSe_2$ deposition. Cells of about 8% efficiency have been made and with short circuit currents of up to 40 mA/cm^2. CdTe films have been grown with and without intentional doping to yield high resistivity p-type material in the as deposited conditions. Subsequent air heat treatments and annealing in a Te overpressure have been successfully used to lower the resistivity by one or two orders of magnitude. Material characterization studies on the CdTe films are reported.

25690 **(SERI/STR—211-2247) Chemical vapor deposited copper indium diselenide thin film materials research. Final report, 15 November 1982-14 January 1984.** (Poly Solar, Inc., Garland, TX (USA)). Mar 1984. Contract AC02-83CH10093. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84004488.

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The objective of the contract is to demonstrate the feasibility of producing device-quality copper indium diselenide films by the close-spacing chemical vapor transport (CSCVT) technique. The technical approaches used in this work consist of (1) the preparation of the $CuInSe_2$ source material by direct synthesis and the characterization of its properties, (2) the deposition of $CuInSe_2$ films on conducting and insulating substrates by the CSCVT technique, and (3) the formation and characterization of heterojunction solar cells. During the course of this subcontract, a number of copper indium selenide ingots (source material) have been synthesized from the elements, and their structural and electrical properties characterized. The deposition of p-type $CuInSe_2$ films on graphite, alumina, and coated graphite substrates by the CSCVT technique using iodine and hydrogen iodide as the transport agent has been carried out under a wide range of conditions. The compositional, structural, and electrical properties of $CuInSe_2$ films have been characterized. A number of n-ZnO/p-$CuInSe_2$ and n-CdO/p-$CuInSe_2$ heterojunction solar cells have been prepared by the deposition of the transparent oxide on p-$CuInSe_2$ films by ion-beam sputtering. The AM1 efficiency of these cells is in the range of 2% to 3%.

25691 **(SERI/STR—211-2280) Spray solar cell research: CdS/Cu_2S cells by ion exchange - CSD. Final report, 1 September 1980-28 February 1981.** Maruska, H.P.; Young, A.R. II. (Exxon Research and Engineering Co., Annandale, NJ (USA). Corporate Research Labs.). Mar 1984. Contract AC02-83CH10093. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84004490.

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The study was performed to develop a novel chemical spray deposition/ion exchange process for the Cu_2S/CdS solar cell, defining deposition processes and parameters that would lead to conversion efficiencies over 8%. Work was concentrated mainly in the areas of CdS resistivity and junction formation. The film resistivity was lowered to less than 100 Ω-cm. Dark mobilities of these films were about 10 cm^2/V-sec, which can increase to about 100 cm^2/V-sec under illumination. An analytical procedure was used for extracting the bulk mobility and carrier concentration at the core of the grains. Apparatus was set up to allow the vacuum evaporation of cuprous halides onto the converted CdS films, followed by in situ vacuum heat treatments. However, all of the finished cells had disappointingly poor characteristics, e.g., the short-circuit currents were low. The best short-circuit current achieved in a CdS/Cu_2 cell made with converted material was 0.5 mA/cm^2. The same problem was encountered using high-quality CdS films.

25692 **(SERI/TP—231-1699) Aquatic biomass as a source of fuels and chemicals.** Raymond, L.P. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1983. Contract AC02-77CH00178. 11p. NTIS, PC A02; 3; GPO Dep. Order Number DE84000017.

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The Aquatic Species Program (ASP) addresses the development of technologies that produce and utilize plant biomass species which naturally inhabit wetlands or submerged areas. Processes being developed through this program take advantage of the rapid growth rates, high yields, and extraordinary chemical compositions inherently associated with aquatic species. Emphasis is placed on salt tolerant species for cultivation on poorly utilized, low-value lands, where conventional agriculture is not economic. Candidate species are identified from: (1) microalgae-unicellular plants that are natural factories for converting sunlight into high quality oils; (2) macroalgae-large, chemically unique plants that can be easily fermented to methane gas or alcohols; and (3) emergents-plants that grow rooted in waterways and bogs, but are partially exposed above water. Within the next five years, the conditions and resources necessary for sustained systems operations are to be defined, design parameters examined, and experimental facilities developed. Succeeding years are planned to focus on resolving major technical hurdles in systems operations, integration, and component performance. This paper updates the technical progress in this program, describes several aspects of evolving systems concepts, and attempts to provide some perspectives based on potential economics. 16 references, 4 figures, 4 tables.

25693 **(SLU-ESO-TR—30) Results from the first preliminary test with short rotation willow clones.** Sennerby-Forsse, L.; Siren, G.; Lestander, T. (Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard). 1983. 37p. (In Swedish and English). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84770227.

A case study of the performance of 21 Salix clones was carried out on one year old shoots during 1978 to 1981 as a part of the test programme for fastgrowing willows. The aim was to establish the stability and variation in several important traits in order to elaborate an early testing method. The survival,Frost resistans,Wood quality,Dry content and dry matter production were established for each clone. The result of the study indicated that a suitable period for a preliminary test would be three to four years. Survival percentage in easily rooted clones was about 95% during the period concerned. Mean height of shots increased during the two first years and stabilized after that. The number of stools increased with a factor 9.3 in all clones. Two of the clones were seriously damaged by winter frost,While frost hardiness was high in the other clones. Clonal specific gravity in wood without bark varied between 0.26-0.43 g/cm^3. The clones could be separated into three significant different groups with high,Medium and low wood density. The average moisture content of wood without bark was 54.1% in mid-winter. Moisture content varied in all clones between different years but was stable within clones during one and the same year. Bark percentage varied between clones and also within clones during different yers. Two clones showed significantly higer bark percentages than the others. The annual stemwood production increased steadily from year 1978-1981. 10 clones out of the 21 tested produced more than 600 g dry matter per stool during the fourth year.

25694 **(TVA/ONR/LFR—83/33) Evaluation of logging systems designed to recover harvesting residues for energy.** (Tennessee Valley Authority, Norris (USA). Div. of Land and Forest Resources). Aug 1983. 52p. NTIS, PC A04/MF A01. Order Number DE84900351.

Computer simulations of three different harvesting systems on four different timber stands are described. The simulations include the production of conventional timber products from the boles of the harvested trees and chips from the limbs and tops. Functional and total costs of production per ton for products and chips are given. An analysis of the suitability of the harvesting systems's abilities to retrieve forest residues within a competitive economy is made. 21 references, 3 figures, 25 tables.

25695 **High-efficiency beam-processed solar cells.** Wood, R.F. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 12-13(Fal 1983).

A review of the research being conducted at ORNL on beam processing to make high-efficiency silicon solar cells is presented. Laser processing is both energy-efficient and cost-effective and indications are that the processing can be easily automated, something that has not been achieved in the solar cell industry to date.

25696 **Silicon crystal growing by oscillating crucible technique.** Schwuttke, G.H.; Kim, K.M.; Smetana, P. (to Dept. of Energy). US Patent Application 6-521,497. 3 Aug 1983. 14p. Contract AI01-76ET20356.

A process for growing silicon crystals from a molten melt comprising oscillating the container during crystal growth is disclosed.

25697 **Method and apparatus for producing high purity silicon.** Olson, J.M. (to Dept. of Energy). US Patent Application 6-498,999. 27 May 1983. 19p. Contract AC02-77CH00178.

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A method for producing high purity silicon includes forming a copper silicide alloy and positioning the alloy within an enclosure. A filament member is also placed within the enclosure opposite the alloy. The enclosure is then filled with a chemical vapor transport gas adapted for transporting silicon. Finally, both the filament member and the alloy are heated to temperatures sufficient to cause the gas to react with silicon at the alloy surface and deposit the reacted silicon on the filament member. In addition, an apparatus for carrying out this method is also disclosed.

25698 **Regional impacts of herbaceous and woody biomass production on U.S. agriculture.** Shen, S.Y.; Turhollow, A.F. (Argonne National Lab., Argonne, IL). pp 207-234 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—). Contract W-31-109-ENG-38.

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

Large-scale biomass production from wood grass, kenaf, and herbaceous grass is possible in the United States, while at the same time meeting domestic and export food demands. A five land group, interregional, linear, programming model of the U.S. agricultural sector is developed to estimate the cost of producing biomass, the regional distribution of biomass, the adjustments that agriculture must make to biomass production, and the tradeoffs that exist between biomass and food production. Wood grass is a new concept. It utilizes high density planting of coppicing woody species so that annual harvest is profitable. Two levels of woodgrass yields are incorporated into the model. For lower wood-grass yields, kenaf is the primary source of biomass and biomass producers would have to receive between $2.11 and $4.40 per million Btu of biomass energy. For high woodgrass yields, the producer cost is between $1.20 and $1.49 per million Btu. Soil loss associated with biomass production is analyzed in detail. It is found that soil loss is a strong function of kenaf production, but wood grass is a soil conserving crop.

25699 **Catalytic steam gasification of biomass for methanol and methane production.** Mudge, L.K.; Baker, E.G.; Brown, M.D.; Mitchell, D.M.; Robertus, R.J. (Pacific Northwest Laboratory, Richland, WA). pp 365-412 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—).

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

The Pacific Northwest Laboratory (PNL) is conducting an ongoing project, sponsored by the Biomass Energy Technology Division of the U.S. Department of Energy, on the gasification of biomass in the presence of catalysts. The purpose of the project is to evaluate the technical and economic feasibility of producing specific gas products via the catalytic gasification of biomass. This report presents the results of research conducted from October 1980 to November 1982. The project was comprised of laboratory studies, process development, and economic analyses. The laboratory studies were conducted to develop operating conditions and catalyst systems for generating methane-rich gas, synthesis gases, hydrogen, and carbon monoxide. The process development unit (PDU), previously used for tests at atmospheric pressure, was modified for operation at absolute pressures of up to 10 atm (1000 kPa). A program for use on a microcomputer was written to determine the effect of yield changes at elevated pressures on process economics.

25700 **Environmental characterization studies of a high throughput wood gasifier.** Chang, H.; Niemann, R.C.; Wilzbach, E. (Argonne National Laboratory, Argonne, IL). pp 539-544 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—).

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

Potential environmental effects associated with thermochemical biomass gasification have been studied by Argonne National Laboratory in cooperation with Battelle Columbus Laboratories (BCL). A series of samples from the process research unit of an indirectly heated, high throughput wood gasifier operated by BCL has been analyzed for potentially toxic organic compounds and trace elements. The results indicate that, under the test run conditions, the gasification of both pine and hardwood is accompanied by the formation of some oil, the heavier fraction of which gives a positive response in the Ames assay for mutagenicity and contains numerous phenols and polycyclic aromatic hydrocarbons, including some carcinogens. The implications of these observations are discussed.

25701 **Microalgal production of oils and lipids.** Lien, S.; Spencer, K.G. (Solar Energy Research Inst., Golden, CO). pp 1107-1122 of Energy from biomass and wastes VII. Chicago, IL; Inst. of Gas Tech. (1983). (CONF-830114—). Contract AC02-77CH00178.

From 7. annual symposium on energy from biomass and wastes; Lake Buena Vista, FL, USA (24 Jan 1983).

Microalgae of aquatic and soil origins contain an efficient photosynthetic system tightly coupled to the versatile biosynthetic cellular metabolism of these organisms. Under appropriate conditions and with a net intake of CO_2 and H_2O, some species of microalgae accumulate massive amounts of oils and lipids as storage material. The storage lipids and oils are readily extractable and easily separated from the remaining algal mass. Due to their high content of reduced carbon moieties, algal oil and lipids can be converted into fuels without a large input of additional chemical energy. Chemically, the major fraction of algal oil and storage lipids are triacylglycerides. They contain fatty acids of varying lengths which may also include hydroxyl, keto, epoxy and other functional groups. Thus, algal oils and lipids may also be used as renewable sources of petrochemical replacement. Currently, SERI is conducting a systematic survey to evaluate the oil and lipid production capacity of microalgae. Laboratory results indicate that several fastgrowing species of green algae are capable of producing and accumulating intracellular oil well in excess of 60% of the total dry algal mass. In addition, some of these species can tolerate a salinity of 0.3 M NaCl. The implication of these findings on the adaptation of microalgae as transducers of solar energy to fuels and chemicals is discussed.

25702 **Formation of aromatic compounds from condensation reactions of cellulose degradation products.** Russell, J.A.; Miller, R.K.; Molton, P.M. (Pacific Northwest Laboratory, Richland, WA). *Biomass;* **3**: No. 1, 43-57(1983). Contract AC06-76RL01830.

This research was undertaken to understand the formation of aromatic compounds when cellulose is liquefied in an aqueous alkaline environment. Work done by other authors shows that low molecular weight aldehydes and ketones can form aromatic compounds via condensation reactions under a variety of reaction conditions. Selected aldehydes and ketones which might have formed from cellulose degradation were reacted under cellulose liquefaction conditions. Many of the same aromatic compounds were formed from these reactions as were found in cellulose derived oils. Although the exact mechanisms may in some cases be complex, the

condensation and cyclisation of these aldehydes and ketones is apparently involved in the formation of aromatic compounds in cellulose liquefaction oils.

25703 **Bioconversion of solar energy.** Calvin, M. (Lab. of Chemical Biodynamics Univ. of California Berkeley, CA 94720). pp 645-659 of Trends in photobiology. Helene, C.; Charlier, M.; Montenay-Garestier, Th. New York, NY; Plenum Publishing Corp. (1982). (CONF-800762—). Contract W-7405-ENG-48.

From 8. international congress on photo-biology; Strasbourg, France (20 Jul 1980).

This chapter examines photosynthesis as an annually renewable resource for material and energy. Discusses the development of petroleum plantations; alcohol for fuel; hydrocarbon producing plants; synthetic chloroplasts; construction of micelles; photoelectron transfer; electron exchange across the membrane; and the manganese requirement for oxygen production. Reports that a number of synthetic systems have been constructed which are designed to capture and store quanta in the form of stable chemical materials, some as energy sources and some as special and valuable products difficult to obtain in any other way. Predicts the creation of an artificial system for photosynthesis based upon the synthetic chloroplast.

25704 **Comparison studies on the effects of ultraviolet irradiation on photosynthesis.** Mantai, K.E.; Wong, J.; Bishop, N.I. (Oregon State Univ., Corvallis). *Biochimica et Biophysica Acta;* **197**: 257-266(1970).

A comparison of chloroplasts from which plastoquinone had been extracted with ultraviolet irradiation supports the conclusion that plastoquinone destruction is not the major cause of ultraviolet inhibition of photosynthesis. No photodestruction of chloroplast lipids, carotenoids or soluble proteins by ultraviolet irradiation was detected. Phenazine methosulfate-mediated cyclic photophosphorylation and variable yield fluorescence were inhibited at the same rate as the Hill reaction. Examination of fluorescence emission spectra of chloroplasts and whole algal cells revealed decreases in both the 685-nm and long-wavelenth emission peaks. Digestion of chloroplasts with lipase decreased fluorescence in a manner similar to ultraviolet irradiation. Hill reaction activity was also inhibited by lipase digestion. It is concluded that the inhibition of photosynthesis by ultraviolet irradiation is most likely due to a disruption of the structural integrity of the lamellar membranes which results in the loss of System II activity and associated reactions. 8 references, 8 figures, 1 table.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 25671, 25672, 26163

25705 **(SAND—83-2015C) Verification of photovoltaic system modeling codes based on system experiment data.** Menicucci, D.E.; Fernandez, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 16p. (CONF-840561—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010979.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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The ability to predict system performance is important to the design, evaluation, and economic justification of a photovoltaic (PV) system. Of the many performance models available, little effort has been devoted to assessing their accuracy. This paper describes verification effort to quantify the accuracy of the PV F-Chart and SOLCEL-II performance models based on field data. The SOLCEL-II and PV F-Chart models were selected because of their availability, past use, and documentation. The PV F-Chart model is a simple microcomputer designed to predict long-term performance for planned PV systems. The SOLCEL-II model is a more complex model, requires hourly input data, and is most applicable for use by engineers in evaluating an existing PV system. This effort confirms that both models meet their design objectives accurately.

25706 **(SAND—83-2117C) Assessment of power conditioning for photovoltaic central power stations.** Chu, D.; Key, T.S. (Sandia National Labs., Albuquerque, NM (USA)). 1 May 1984. Contract AC04-76DP00789. 23p. (CONF-840561—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011188.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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This paper presents results of power conditioning subsystem (PCS) research and development for central station photovoltaic (PV) applications. We have found that advanced power semiconductor devices, new circuit designs, and improved packaging techniques coupled with production volume can reduce PCS costs per kilowatt by a factor of four. PV array field modularity offers several options in central station PCS power and voltage ratings. PCS development potential for two size ranges, 50 to 500 kW and 1 to 10 MW, will be examined and compared.

25707 **(SAND—84-0993C) Performance evaluation of large-scale photovoltaic systems.** Fuentes, M.K.; Fernandez, J.P. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Engineering Research Inst., Albuquerque (USA)). 1 May 1984. Contract AC04-76DP00789. 6p. (CONF-840561—9). NTIS, PC A02; 3; GPO Dep. Order Number DE84011187.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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Over the past several years, the US Department of Energy has fielded a number of large-scale photovoltaic (PV) systems as initial experiments for assessing the performance of various PV designs. The array power and power conditioning subsystem (PCS) data have been analyzed from the following six sites: Sky Harbor Airport, Dallas-Fort Worth Airport, Newman Power Station, Lovington Shopping Center, Beverly High School, and the Oklahoma Center for Science and Arts. For all these systems, the peak power was determined to be within 67% of the rated peak. The differences between the actual peak power and rated peak power has been attributed to a number of factors, includ-module failures and array degradation. The peak PCS efficiencies range from 88% to 93%.

25708 **(SERI/SP—281-2190) Photovoltaics for residential applications.** (Solar Energy Research Inst., Golden, CO (USA)). Feb 1984. Contract AC02-83CH10093. 22p. NTIS, PC A02/MF A01 - GPO.

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Information is given about the parts of a residential photovoltaic system and considerations relevant to photovoltaic power use in homes that are also tied to utility lines. In addition, factors are discussed that influence implementation, including legal and environmental factors such as solar access and building codes, insurance, utility buyback, and system longevity. (LEW)

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 27051

25709 **(ATR—77(7523-22)-3) Solar thermal conversion mission analysis. Final report.** McKoy, G.; Latta, A.; Janz, R. (Aerospace Corp., El Segundo, CA (USA)). 25 Feb 1978. Contract AT03-76CS51101. 294p. (STMPO—015). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE84010539.

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Analyses of conceptual systems, missions, and economic factors governing the generation of electrical power by solar thermal conversion techniques were performed. These analyses have focussed on large (greater than 100 MW) central solar power plants intended for electric power generation. Most of the methodology developed during these analyses and some of the analytical results were described in an earlier document. This report extends those

results and describes the application of previously developed methodologies to the determination of solar thermal power plant performance and operating economics for additional sites throughout the US. It represents a compilation of material which has been published previously in other forms.

25710 **(ATR—78(7695-05)-1) Pilot plant computer model (STMPPS): preliminary description.** (Aerospace Corp., El Segundo, CA (USA)). 08 Feb 1978. Contract AT03-76CS51101. 36p. (STMPO—021). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008927.

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This report is a preliminary description of Aerospace's approach to implementing that Solar Ten Megawatt Pilot Plant Simulation (STMPPS). Program STMPPS is being developed as a dynamic digital computer simulation to be both employed by the STMPO in their own studies and offered to the Plant integrating contractor for his design efforts.

25711 **(ATR—81(7747)-4) Infrared sensor for remote temperature monitoring of solar thermal central receivers.** Warren, D.W.; Eden, H.D.; Thompson, J.S. (Aerospace Corp., El Segundo, CA (USA)). 1984. Contract AC03-78ET20517. 24p. (STMPO—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009889.

The discussion traces the analysis leading to the original sensor specification for monitoring the temperature of the boiler tubes of the Barstow 10 MW Solar Pilot Plant and will hopefully prove useful to those faced with a similar application. Results of tests performed to date are discussed, as are the upgraded Pilot Plant model and the potential of the system for more sophisticated monitoring tasks.

25712 **(DOE/ET/21060—3) Preliminary simulation of the MDAC receiver panel test sequences to be implemented at the CR-STTF.** (Aerospace Corp., El Segundo, CA (USA). Energy Projects Directorate). 23 Feb 1979. Contract AT03-76ET21060. 51p. (STMPO—026). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84008925.

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A McDonnell-Douglas/Rocketdyne (MDAC) once-through central receiver design has been selected as the plant's solar-to-electrical energy conversion device for the Barstow, California 10MW Solar Thermal Pilot Plant. In order to augment the data which will be produced by the Pilot Plant operation and to assist in the detail design of the Pilot Plant receiver itself, an early series of tests on a full-size MDAC receiver panel has been planned at the DOE Central Receiver-Solar Thermal Test Facility (CR-STTF) in Albuquerque. A dynamic digital computer simulation of that STTF-MDAC receiver panel configuration has been developed by the Aerospace Corporation. The purpose of such a simulation is to permit early, inexpensive studies of proposed test sequences and rapid investigations of potential control schemes. The results of those studies could give experimenters valuable insight into equipment performance parameters, and thus permit prudent limiting of actual hardware test time on the more expensive facility. The program contains modules to simulate the collector field, cooling subsystem, steam depressurization and desuperheat subsystem, feedwater regenerative heat exchanger, MDAC receiver panel, and control subsystem. Facility controllers have been modeled pursuant to data received from STTF personnel, but in one case (the Feedwater Pressure Control Loop) a simulation gain constant had to be altered to prevent instability. Two other controllers, the Feedwater Inlet Temperature and the Receiver Outlet Steam Temperature, were also modeled with gain constants selected by Aerospace in the absence of any specified values. The results reported here indicate that the gains selected by Aerospace for that steam temperature controller are not optimum and must be further refined.

25713 **(DOE/JPL—1060-62) Solar tests of aperture plate materials for solar thermal dish collectors.** Jaffe, L.D. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Aug 1983. Contract AT04-81AL16228. 79p. (JPL-PUB—83-68). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84009157.

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In parabolic dish solar collectors, walk-off of the spot of concentrated sunlight can be a hazard if a malfunction causes the concentration to stop following the sun. Therefore, a test program was carried out to evaluate the behavior of various ceramics, metals, and polymers under solar irradiation of about 7000 kW/m^2 (peak) for 15 minutes. The only materials that did not slump or shatter were two grades of medium-grain extruded graphite. High-purity, slip-cast silica might be satisfactory at somewhat lower flux. Oxidation of the graphite appeared acceptable during tests simulating walk-off, acquisition (2000 cycles on/off sun), and spillage (continuous on-sun operation).

25714 **(DOE/JPL—1060-67) Publications of the JPL Solar Thermal Power Systems Project, 1976 to 1983.** Gray, V.; Marsh, C.; Panda, P. (comps.). (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Jan 1984. Contract AC04-76DR00789. 62p. (JPL-PUB—84-1). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84008501.

The bibliographical listings in this publication are documentation products associated with the Solar Thermal Power Systems Project carried out by the Jet Propulsion Laboratory from 1976 to 1983. Documents listed herein are categorized as conference and journal papers, JPL external reports, JPL internal reports, or contractor reports (i.e., deliverable documents produced under contract to JPL). Alphabetical listings by title were used in the bibliography itself to facilitate location of the document by subject. Two indexes are included for ease of reference: one, an author index; the other, a topical index.

25715 **(DOE/JPL—1060-69) Fifth parabolic dish solar thermal power program annual review: proceedings.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Mar 1984. Contract AM04-80AL13137. 267p. (CONF-831274—). NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84008503.

From 5. parabolic dish solar thermal power program annual review meeting; Indian Wells, CA, USA (6 Dec 1983).

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The primary objective of the Review was to present the results of activities within the Parabolic Dish Technology and Module/Systems Development element of the Department of Energy's Solar Thermal Energy Systems Program. The Review consisted of nine technical sessions covering overall Project and Program aspects, Stirling and Brayton module development, concentrator and engine/receiver development, and associated hardware and test results to date; distributed systems operating experience; international dish development activities; and non-DOE-sponsored domestic dish activities. A panel discussion concerning business views of solar electric generation was held. These Proceedings contain the texts of presentations made at the Review, as submitted by their authors at the beginning of the Review; therefore, they may vary slightly from the actual presentations in the technical sessions.

25716 **(DOE/SF/10501—009) 10-MWe Solar Thermal Central Receiver Pilot Plant. Overall Plant Design Description.** (Southern California Edison Co., Rosemead (USA)). Mar 1978. Contract FC03-77SF10501. 215p. (STMPO—053). NTIS, PC A10; 3; GPO Dep. Order Number DE84008896.

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This Overall Plant Design Description (OPDD) constitutes the principal means to establish, describe, and control the design of the 10 MWe Solar Thermal Central Receiver Pilot Plant. The specific functions and design requirements to be satisfied by the design in accordance with overall project technical requirements are first detailed. The design description, plant limitations, set points and precautions, operation, casualty events and recovery, and maintenance are discussed.

25717 **(DOE/SF/10501—013) 10 MWe solar thermal central receiver pilot plant operational test management plan: update, April 1984.** (Southern California Edison Co., Rosemead (USA)). Apr 1984. Contract FC03-77SF10501. 18p. (STMPO—061). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008955.

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The five-year operational test period was scheduled to begin in mid-1982. This test period is to consist of an approximately 2-year experimental test and evlauation phase followed by a three-year power production phase. The experimental test phase is to provide operational experience in all the operational modes, measure plant performance, and establish stable controlled operation of the pilot plant. The Operational Test Management Plan describes the procedures and responsibilities for managing the plant's operation during the five-year testing period. The plan defines the management structure and specifies the responsibilities for developing test procedures, safety procedures, and plant performance evaluation. Budgeting responsibilities and data generation and distribution procedures are also described. This plan will be reviewed and updated periodically. A specific review will be made near the end of the two-year experimental test phase to determine what changes, if any are needed in the management structure prior to the power production phase.

25718 **(DOE/SF/10501—T13) Solar 10-MWe pilot plant fact sheet. Revision 2.** (Solar One Visitor Center, Daggett, CA (USA)). May 1983. Contract FC03-77SF10501. 30p. (STMPO—602-Rev.2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84006353.

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Characteristics are detailed of the Solar 10 MWe Central Receiver Pilot Plant. The plant is a cooperative effort between the Department of Energy and the Associates - Southern California Edison Company, the Los Angeles Department of Water and Power and the California Energy Commission. This experimental pilot plant provides new opportunities for technology improvement which will be incorporated into future commercial size plants. The plant will fulfill its primary role of supplying technical performance data on the systems described herein and exploring the best ways to utilize solar energy.

25719 **(DOE/SF/10539—12) Software/firmware design specification for 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant.** Ladewig, T.D. (Martin Marietta Corp., Denver, CO (USA). Denver Aerospace). Jan 1982. Contract AC03-80SF10539. 1103p. (STMPO—299; MCR—80-1377A). NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84011450.

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This Collector Subsystem Software/Firmware Design Specification exists as a stand-alone document to provide a complete description of the software and firmware employed for the operation of the 10 MWe Solar Thermal Central Receiver Pilot Plant Collector Subsystem. The software/firmware systems have the capability to allow operator control of up to 2048 heliostats in the operation of the 10 MWe Solar Thermal Central Receiver Pilot Plant at Barstow, California. This function includes the capability of operator-commanded mode control, graphic displays, status displays, alarm generation, system redundancy and interfaces to the Operational Control System (OCS), the Data Acquisition System (DAS), and the Beam Characterization System (BCS) through the OCS. The operational commands will provide for the following: (a) safe beam movement whenever automatic beam movement is required; (b) single and multiple heliostat addressing; (c) emergency heliostat movement for high-wind conditions and receiver problems; and (d) recovery for full or partial power-loss conditions. The control hardware consists of a host computer, the Heliostat Array Controller (HAC), interfaced to a group of communication controllers, the Heliostat Field Controllers (HFCs), communicating with individual processors, the Heliostat Controllers (HCs), which monitor and command a single heliostat. The system consists of two HACs and 64 HFCs with up to 32 HCs per HFC.

25720 **(FRNC-TH—1403) Contribution to the study of medium solar power plants.** Picot, O. (Nice Univ., 06 (France)). Jan 1982. 197p. (In French). NTIS (US Sales Only), PC A09; 03. Order Number DE84751355.

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The different types of thermodynamic solar plants useable in the 100-1000 kW range are presented. The choices carried out during a study of the Bertin Company, that lead to define the prototype solar power plant of Vignola in Corsica (France) are explained (specifications, distributed collectors). The problem of optimal dimensioning is examined from a technico-economic point of view. The last part deals with a special problem of solar plants: the regulation of the collecting loop.

25721 **(MCR—84-537) Prototype design of an advanced ceramic receiver. Final report.** (Martin Marietta Aerospace, Denver, CO (USA)). Apr 1984. Contract AC03-83SF11938. 47p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84009695.

The purpose of the activities described in this report is to investigate an advanced gas receiver design concept. The advanced gas reactor design concept utilizes a translucent ceramic tube packed with a solar absorbing, porous material. A gas is pumped through the tube and is heated to a high temperature by direct solar energy incident on the tube surface. The basic energy exchange mechanisms are the transfer of the incoming solar flux through the translucent tube, the absorption of the solar energy by the packing material, and the convective transfer of the absorbed solar energy from the packing material to the gas. The approach taken for this activity was to develop a conceptual design of a commercial size receiver, investigate critical design elements of the commercial receiver, develop a preliminary design of a prototype, and identify the appropriate facility for testing the prototype. In order to develop the conceptual design of the commercial size receiver a thermo/hydraulic numerical model of the tube was devised. This model yields predictions of the thermal performance of the tube along with estimates of the tube pressure drops. A detailed description of the model is given in section IIIA of this report. Using the model it was possible to establish an optimum tube diameter and length for a commercial size receiver. With the tube dimensions known it was then possible to perform design studies to determine tube stresses and attachment schemes.

25722 **(SAND—81-8192/1) Alternate central receiver power system, Phase II. Volume I. Executive summary. Final report.** (Martin Marietta Corp., Denver, CO (USA). Denver Aerospace). Jan 1984. Contract AC04-76DR00789. 130p. NTIS, PC A07; 3; GPO Dep. Order Number DE84009610.

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The objective of the Phase II Alternate Central Receiver program was to demonstrate the feasibility of the molten salt central receiver power system by conducting a series of experiments and using the results to update the commercial-scale design developed during Phase I of the program. The experiments were directed at two levels of inquiry: the systems-level testing of a 5 MW/sub th/ molten salt receiver - hereafter referred to as the receiver SRE; and the investigation of molten salt chemistry and the compatibility of selected materials with molten salt. Detailed discussion of the receiver testing are contained in Volume II of this report, while the materials tests are the subject of Volume III.

25723 **(SAND—81-8192/3) Alternate central receiver power system, Phase II. Volume III. Molten salt materials tests. Final report.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Jan 1984. Contract AC04-76DR00789. 273p. NTIS, PC A12; 3; GPO Dep. Order Number DE84009207.

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The objective of the Phase II Alternate Central Receiver program was to demonstrate the feasibility of the molten salt central receiver power system by conducting a series of experiments and using the results to update the commercial-scale design developed during Phase I of the program. The experiments were direct-

ed at two levels of inquiry: the systems-level testing of a 5 MW/sub th/ molten salt receiver - hereafter referred to as the receiver SRE; and the investigation of molten salt chemistry and the compatibility of selected materials with molten salt. Detailed discussion of the receiver testing are contained in Volume II of this report, while the materials tests are the subject of this volume. The materials and salt chemistry research experiments were designed to answer important questions on the use of molten salt mixtures of sodium and potassium nitrate in solar receiver applications. The experiments were conducted to provide data in the areas of molten salt stability and materials compatibility which could be used in designing a commercial molten salt solar central receiver power system with a lifetime of 30 years or more. Four different categories of tests were conducted: (1) materials compatibility; (2) materials mechanical properties; (3) dynamic testing; and (4) salt chemistry tests.

25724 (SAND—82-8048, pp 15-20) **US solar thermal status and outlook.** Braun, G.W. May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

This paper is an overview of USDOE's solar thermal energy program. A review of extant projects is given; oriented around the three basic technologies which have been concentrated on: central receivers, parabolic troughs and parabolic dishes. Cost factors, design problems and directions of future development are outlined. International cooperative programs and the potential for domestic technology transfer are discussed.

25725 (SAND—82-8048, pp 21-28) **Themis program.** Drouot, L.P. May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

This paper is a review of the history and organization of the Themis project being carried out by the French Agency for the Management of Energy. The organizational structure, cost breakdown, experimental program and management structure of the project are discussed and diagrammed.

25726 (SAND—82-8048, pp 29-44) **2500 KW Themis solar power station at Targasonne.** Hillairet, M.J. (Electricite de France, Paris). May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

The history to date of the Themis project is presented. The Themis project location (Targonne, in the Pyrennes is described, as is the climate of the local. The basic design of the plant is described and illustrated. Various problems that have occurred are discussed, and a comparison of the output and reliability of the plant with a nuclear plant is made.

25727 (SAND—82-8048, pp 45-74) **1 MWe central receiver type solar thermal electric power pilot plant.** May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

The Japanese Sunshine Project is reviewed. The basic design of the power plant (a tower focus system) is discussed. Operational characteristics are discussed and evaluated. Directions for future work are outlined. Specifications of the various subassemblies that make up the plant are presented in tables.

25728 (SAND—82-8048, pp 75-100) **Central Receiver System (CRS) in the small solar power systems project (SSPS) of the International Energy Agency (IEA).** Grasse, W.; Becker, M. May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

A review of the design and preliminary operation of the central receiver facility at Almeria, Spain design and construction details are discussed and diagrammed. Performance of subassembiles during tests is detailed, as is the basic meteorological data for the area. Operational problems and areas of future research, development and improvement are discussed.

25729 (SAND—82-8048, pp 101-118) **EURELIOS, the 1 MW(el) heleioelectric power plant of the European Community program.** Borgese, D.; Dinelli, G.; Faure, J.J.; Gretz, J.; Schober, G. May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

EURELIOS, the 1 MW(el) solar power plant, is described. It is a project sponsored by the Commission of the European Communities. This plant, of the mirror-field and central receiver type, was designed and built by a consortium of European industries. Specifications for subassemblies are given, along with a listing of problems encountered during construction and initial operation.

25730 (SAND—82-8048, pp 139-152) **Spanish Power Tower solar system: the project CESA-1.** Torralbo, A.M.; Gonzalvez, C.H.; Roses, C.O.; Lacal, J.A.; Sanchez, F. (Ministerio de Industria y Energia, Madrid, Spain). May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

The Spanish tower focus power plant project, CESA-1 is discussed. The organizational structure of the project is diagrammed, as well as intra-project cost projections. Subassembly specifications are tabulated, and a project status report is included. (At press time, the project was near completion. Anticipated start-up was December, 1983).

25731 (SAND—82-8048, pp 153-172) **10 MWe solar thermal central receiver pilot plant.** Bartel, J.J. (Sandia National Lab., Livermore, CA); Skvarna, P.E. May 1983. NTIS, PC A10/MF A01. (CONF-8210194—).

From International workshop on the design, construction, and operation of solar central receiver projects; Claremont, CA, USA (19 Oct 1982).

This paper presents an overview of the Solar One Project at Barstow, California; and discusses costs and schedule, highlights the planned test program, and discusses operation and maintenance experiences up to press time (May, 1983). Detail schematic diagrams of some subassemblies are given, along with a problem/solution table generated during initial tests. The facility began contributing power to the local grid on April 12, 1982.

25732 (SAND—84-8214) **10 MW/sub e/ solar thermal central receiver pilot plant mirror module corrosion survey.** Noring, J.E.; Mavis, C.L.; Decker, E.V.; Skvarna, P.E. (Sandia National Labs., Livermore, CA (USA); Southern California Edison Co., Rosemead (USA)). Mar 1984. Contract FC03-77SF10501;AC04-76DP00789. 52p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84009311.

Mirror module corrosion was first noticed in the heliostat field of the 10 MWe Solar Thermal Central Receiver Pilot Plant near Barstow, California, in February 1982—approximately one year after the first heliostats were installed. The corrosion occurs when water enters the normally sealed mirror modules and penetrates through several protective layers to the reflective silver layer of the mirrors. In August 1983, a survey of all 1818 heliostats was completed which documented the extent of this corrosion. This report is a full summary of that survey. The major findings of the survey are: (1) 0.015% of the total reflective surface of the heliostat field is corroded; (2) 15% of all the modules have some amount of corrosion; (3) 65% of all the corrosion occurs in the northeast quadrant of the field; (4) 85% of all the corrosion is located on the left-hand side (odd-numbered) modules; and (5) mirror modules manufactured before July 1, 1981, are ten times more likely to develop corrosion than those manufactured after this date. The great reduction in mirror module corrosion for those manufactured after

July 1, 1981, was due to a change in the clamping procedure used for the edge seal adhesive curing step. Plans are currently under way to retrofit about half of the mirror modules in the field with drying vents.

25733 **Considering in siting solar electric power plants.** Williams, T.A. (Pacific Northwest Lab., Richland, WA). pp 145 of 5th Miami international conference on alternative energy sources. Vezirogla, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

1408 Ocean Energy Systems

REFER ALSO TO CITATION(S) 26768

25734 **(CONF-790444—4) OTEC pilot plant heat engine.** Richards, D.; Perini, L.L. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1979. Contract AI01-77ET20342. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009331.

From Offshore technology conference; Houston, TX, USA (30 Apr 1979).

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The preliminary engineering design has been completed for a pilot plant intended to demonstrate the construction feasibility, performance, operation, and economics of power generation on ocean thermal energy conversion (OTEC) plant-ships utilizing the temperature difference between the surface and deep waters of the tropical oceans. This paper summarizes the heat-engine system design and integration in the platform and describes system components and their performance and construction requirements, together with the computed overall cycle performance and operation. Ancillary equipment and platform arrangement and support requirements are discussed as to their effect on the platform design. The heat engine and platform design is based upon the folded-tube, shell-less heat exchanger module concept as developed from analytical and experimental work previously reported. The heat engine design discussed is among the candidates for the construction of large commercial OTEC plant-ships. The pilot plant design presented is for a 10 to 20 megawatt net output plant made up of 2.5-MW/sub e/ net heat exchanger modules manifolded to 5 MW/sub e/ net turbine-generator sets.

25735 **(CONF-790803—67) Preliminary design of a cruising OTEC modular experiment.** George, J.F.; Richards, D. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1979. Contract AI01-77ET20342. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009396.

From 14. intersociety energy conversion conference; Boston, MA, USA (5 Aug 1979).

Ocean Thermal Energy Conversion (OTEC) uses the temperature difference (ΔT) between warm surface water and cold deep water in a thermodynamic cycle with ammonia as the working fluid to drive a turbogenerator. This power source is available over vast areas of tropical and subtropical oceans. The Department of Energy development plan for OTEC calls for the acquisition of a modular experiment platform that can produce from 10 to 40 MW/sub e/ (net) power, using near full-scale power module components. A preliminary design of this platform has been completed and is available for use by Government and industry. The paper describes the systems design of the OTEC platform, which integrates all of the requirements of seawater delivery, heat exchangers, power system components, and shipboard outfitting and furnishing. The cold water pipe is the most difficult technical problem to be solved, and the analysis, design and deployment studies are discussed.

25736 **(CONF-8208114—2) OTEC in Pan America.** Francis, E.J. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1982. Contract AI01-77ET20342. 20p. NTIS, PC A02; 1; GPO Dep. Order Number DE84009330.

From 2. national conference on renewable energy technologies; San Juan, Puerto Rico (1 Aug 1982).

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The paper highlights the financing potential and commercial competitiveness of 40 to 60 MW demonstration scale and larger 100 to 360 MW commercial-scale OTEC vessels. It discusses the market potential within Pan Ametrica for electric power to Caribbean Islands, methanol for fuel and other uses, ammonia, electric power to the US Gulf Coast, Central America and South America, aluminum, electric power via molten carbonate fuel cells, GEOTEC and OTEC produced unleaded gasoline, diesel fuel or jet fuel.

25737 **(DOE/CS/89501—T1) Investigation of heat and mass transport in turbulent liquid jets.** Kim, S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS89501. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84011174.

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Transport processes in a turbulent Newtonian liquid jet issuing from a round nozzle have been studied both experimentally and theoretically. Heat transfer studies were performed by condensing vapor on coherent jets for the following parameter ranges: Reynolds number 6000-40000, saturation temperatures 10-30°C, nozzle diameter 3-7 mm, and length 30 - 120 mm. Long round tubes were used as nozzles in order to have a well specified initial condition. Also varied were kinematic viscosity by testing water jets at different temperatures, surface tension by testing ethanol jets, and initial bulk turbulence level by testing artifically roughened nozzles. The results are in general agreement with previous data for evaporating coherent jets, but severely contradict the Levich-Davies theory. The initial bulk turbulence intensity and surface tension are found to have a dominant effect on turbulent transport rates. In the theoretical study appropriate forms of the governing conservation equations were obtained using an order of magnitude analysis, and solved numerically using a finite difference method. For laminar jets the analysis is essentially exact, while for turbulent jets, transport is approximately modeled using eddy diffusivity models. Various eddy diffusivity models, of varying degrees of complexity, were evaluated through comparison with the experimental data. Shortcomings of the models are discussed. A tentative model which reasonably predicts the present data is suggested.

25738 **(DOE/ET/20342—T4) Internal heat transfer experiments for OTEC evaporator tubes.** Pandolfini, P.P.; Keirsey, J.L. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1977. Contract AI01-77ET20342. 5p. NTIS, PC A02; 3; GPO Dep. Order Number DE84009335.

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In the Applied Physics Laboratory (APL) Ocean Thermal Energy Conversion (OTEC) plant-ship concept, large-diameter (3 to 4 in.) aluminum tubes with ammonia flowing inside are being proposed for use as a low-cost multipass evaporator. Experiments measuring the internal two-phase heat transfer coefficients of ammonia flowing inside a 3-in.-diameter, 20-ft-long aluminum tube have been conducted at the APL Propulsion Research Laboratory. Prior to these tests, no data were available for large-diameter tubes at the heat fluxes that will occur during OTEC operations (1000 to 3000 Btu/h-ft^2). The results provide a basis for predicting the internal heat transfer characteristics needed for the design of an evaporator core unit to be tested in the next phase of the development program.

25739 **(DOE/ET/20342—T5) Preliminary considerations for the selection of a working medium for the solar sea power plant.** Olsen, H.L.; Dugger, G.L.; Shippen, W.B.; Avery, W.H. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). 1973. Contract AI01-77ET20342. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009327.

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Some of the effects of choice of working medium on the estimated size and cost of a 100-MW solar sea power plant (SSPP) are discussed. The working-medium candidates - ammonia, three hydrocarbons, two Freons, carbon dioxide, methyl chloride and ethylene oxide - cover considerable ranges of properties. Other substances considered generally fell within these same ranges of prop-

erties. Only those substances for which the data were most readily available were considered. It is concluded that the present preliminary study gives a decided advantage to ammonia as a choice for the working fluid in a solar sea power plant. However, it is recognized that the selection of an optimum working fluid will require careful evaluation of many factors such as toxicity, materials compatibility, fire and explosive hazards, and plant maintenance and operational factors. Ammonia has problems in several of these areas, whereas propane would have fewer problems. Freons would be better still from a safety and handling standpoint, but plant cost would be higher than for propane. An exhaustive search for other media that may approach the performance of ammonia should be made.

25740 **(DOE/ET/20342—T6) Ocean thermal energy conversion.** Dugger, G.L. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). 1975. Contract AI01-77ET20342. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009325.

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This review on ocean thermal energy conversion discusses the following: conceptual designs for ocean thermal gradient power plants; turbine technology for OTEC applications; the heat exchangers; the cold water pipe; economic assessment; environmental, social, and political impact, interfacing and market capture potential; data and technology needs; and implementation plan.

25741 **(DOE/ET/20342—T7) Testing of the APL OTEC heat exchanger as an evaporator.** Pandolfini, P.P.; Keirsey, J.L.; Funk, J.A. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1979. Contract AI01-77ET20342. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009390.

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The main objective of the APL Ocean Thermal Energy Conversion (OTEC) Program is to demonstrate the feasibility of producing usable energy on a large scale from the temperature differences of tropical oceans, at minimum overall cost. A heat exchanger concept using large-diameter folded aluminum tubes and meeting the cost objective has been under study at APL. In the past year, a full-scale model of the proposed heat exchanger was tested as an evaporator at the Argonne National Laboratory (ANL) in order to obtain experimental data on its novel design and to validate or provide a basis for modifications of the computer code that will be used to estimate performance of an operational unit. The results of the experiment indicate that the unit works very well as an evaporator and that it presents a viable option for an OTEC heat exchanger. The results of the tests of the model as an evaporator were used to modify the correlations that were used in the system studies.

25742 **(DOE/ET/20342—T8) At-sea test of a large diameter steel, cold water pipe.** Blevins, R.W.; Donnelly, H.L.; Stadter, J.T.; Weiss, R.O.; Perez y Perez, L. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1979. Contract AI01-77ET20342. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009393.

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During December 1978 and January 1979, a series of tests were conducted off Santa Catalina Island, California, on a large-diameter steel pipe. The pipe was 5 ft (1.52 m) in diameter and made up in 20-ft (6.10 m) sections to obtain a total length up to 500 ft (152.4 m). Deep Oil Technology's X-1 semi-submersible platform was used to support the pipe through a gimbal joint and the platform was moored with spring buoys in 1000 ft (304.8 m) of water. The objectives were to evaluate the at-sea performance of various configurations and to use the test results to verify or improve existing time and frequency domain analyses of cold-water pipes for Ocean Thermal Energy Conversion (OTEC) plants. The configurations tested were platform alone; platform with 120-ft (36.58 m) pipe, with 300-ft (91.44 m) pipe, with 500-ft (152.4 m) pipe and with 384-ft (117.0 m) pipe including a U-joint at 162 ft (49.38 m). The results of the analyses indicate that the frequency locations of the spectral peaks are generally well predicted, but comparison of the peak values is in poorer agreement.

25743 **(DOE/ET/20342—T10) Biofouling and cleaning experiments for OTEC heat exchangers.** Pandolfini, P.P. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1977. Contract AI01-77ET20342. 3p. NTIS, PC A02; 3; GPO Dep. Order Number DE84009333.

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In the Applied Physics Laboratory (APL) Ocean Thermal Energy Conversion (OTEC) plant-ship concept, large-diameter (3-in.) aluminum tubes with ammonia flowing inside are being proposed for use as low-cost multipass heat exchangers. Experiments to measure the rate of biofouling and its effect on exterior heat transfer have been conducted by APL at the Natural Energy Laboratory of Hawaii, Ke-Ahole Point, Hawaii. The results are directly applicable to the design of the APL heat exchanger.

25744 **(DOE/RA/50164—T1) Assessment of seafloor burial of proposed OTEC power transmission cables. Final report.** Tate, K.W.; Chern, C.; Tudor, W.J. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Jan 1982. Contract AI02-80RA50164. 440p. NTIS, PC A19; 3; GPO Dep. Order Number DE84009845.

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This study assesses the need for protection of the seafloor OTEC power transmission cables, identifies the means, or development requirements for accomplishing the required protection, and determines the costs and benefits associated with this protection. Protection of the bottom cable along the entire route from the shoreline to the riser cable were evaluated at four specific sites. These sites were chosen mainly to represent the rather diverse bottom conditions expected in the OTEC program. Three of the four sites are island sites; they are immediately offshore of: (1) Kahe Point, Oahu, Hawaii; (2) Punta Yeguas, Puerto Rico; and (3) Cabras Island, Guam. The fourth site is in the Gulf of Mexico, due west of Tampa, Florida. A total of 1061 submarine communication cable faults were accumulated and analyzed during the initial portion of this study. For three of the proposed OTEC sites, namely Hawaii, Puerto Rico and Guam, a 90% chance of avoiding the hazards of chafing, corrosion, anchors, and trawling can be achieved by using the proper protection techniques over approximately 1 to 2 nautical miles from shore. The status of seafloor cable protection technology is also addressed in this study. A comprehensive summary identifying the most suitable commercial system has been conducted. Both cable and pipeline protection systems were included as well as previous relevant experience and operating conditions. Guidelines, methods, and procedures for cable protection are given in general for the four proposed OTEC plant sites and cable routes, together with seafloor scenarios and protection strategies for each of the four sites.

25745 **(JHU/APL-OQR—81-4) Ocean thermal energy. Quarterly report, October-December 1981.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1981. Contract AI01-77ET20342. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84005600.

This quarterly report summarizes work on the following tasks: OTEC methanol; approaches for financing OTEC proof-of-concept experimental vessels; investigation of OTEC-ammonia as an alternative fuel; review of electrolyzer development programs and requirements; hybrid geothermal-OTEC power plants: single-cycle performance; estimates; and hybrid geothermal-OTEC power plants: dual-cycle performance estimates.

25746 **(PB—83-221093) Methods for and examples of dynamic load and stress analysis of OTEC (Ocean Thermal Energy Conversion) cold water pipe designs. Volume 1.** Barr, R.A.; Chang, P.Y.; Thasanatorn, C. (Hydronautics, Inc., Laurel, MD (USA)). Nov 1978. Contract AI01-77ET20396. 158p. (DOE/NOAA/OTEC—49). NTIS, PC A08/MF A01.

The design of Ocean Thermal Energy Conversion (OTEC) plant cold water pipes (CWPs) which are structurally adequate and have acceptable weight and cost is a difficult problem. This study and a parallel study by Science Applications Incorporated (SAI)

have been carried to provide information and computer programs to be furnished by the government to the two current CWP preliminary design contractors. This work concerns application of existing methods and development of new methods for analysis of the dynamic, linear response and stressing of an OTEC plant CWP subject to various environmental and operational loads. Included are: CWP structural analysis methods; analysis of CWP static and dynamic loads and responses; analysis of coupled CWP/platform responses; description of computer programs; illustrative examples; validation; and computer program user's manuals.

25747 **(PB—83-221143) Environmental design criteria for the 1/3 scale OTEC (Ocean Thermal Energy Conversion) cold water pipe At-Sea Test Site off Honolulu, Hawaii.** (Noda (E.K.) and Associates, Honolulu, HI (USA)). Jan 1982. Contract AI01-77ET20396. 77p. (DOE/NOAA/OTEC—66). NTIS, PC A05/MF A01.

A fully instrumented At-Sea Test of a 1/3 scale OTEC cold water pipe (CWP) will be carried out. The future prototype for this 1/3 scale model is envisioned to be the OTEC Pilot Plant design in the 10 to 40 megawatt-electric size range with an estimated CWP diameter of about 30 ft and an overall vertical length of about 3000 ft. Thus the 1/3 scale CWP consists of a pipe about 10 ft in diameter and 1000 ft long. The selected At-Sea Test site is located at 21°15.5'N latitude and 157°54.6'W longitude off Honolulu, Hawaii. In order to expedite development of the design of the 1/3 scale At-Sea Test CWP/Platform/Mooring System the report provides environmental design criteria data at the proposed At-Sea Test site evaluated from available historic data.

25748 **(PB—83-221176) OTEC (Ocean Thermal Energy Conversion) CWP (Cold Water Pipe) Laboratory Test Program. Ocean Systems Test Plan.** (Science Applications, Inc., El Segundo, CA (USA)). Sep 1980. Contract AI01-77ET20396. 101p. (DOE/NOAA/OTEC—76; SAI—464-810-007-LA). NTIS, PC A06/MF A01.

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This document presents the plan for validating the ocean systems response codes used in the OTEC community. Ocean systems used here includes the platform, the CWP, and the mooring system. The objectives of the present program are to acquire test data on the response of the ocean system to wave excitation available frequency domain computer codes. If the codes are not fully validated upon comparison of the test data with the calculations, the objectives are to identify discrepancies, establish the range of code usefulness and to recommend improvements. Model tests will be conducted in the OTC model basin with the CWP extending into the 30 foot deep pit. This limits the model scale to 1:110. Three types of prototype CWP's will be modeled: rigid, articulated and compliant. Two mooring stiffnesses will be tested based on the Lockheed mooring study. The model platform is a modified version of the APL barge redesigned to improve seakeeping performance. Computer code calculations will be made with the ROTEC and NOAA/DOE frequency domain codes. Standard response parameters will be compared with the test data (stress and motion maxima, significant and RMS magnitudes as well as selected RAO's). Wave drift forces will be estimated and compared to test data.

25749 **(PB—83-221184) Design of 1/3 scale fiberglass OTEC (Ocean Thermal Energy Conversion) cold water pipe.** (Science Applications, Inc., La Jolla, CA (USA)). Dec 1979. Contract AI01-77ET20396. 63p. (DOE/NOAA/OTEC—64). NTIS, PC A04/MF A01.

The government intends to conduct a 1/3 scale test of a 30-foot diameter reinforced plastic (FRP) cold water pipe (CWP) for use with a 10/40 MWe pilot plant during summer and fall 1980. The test program has two primary objectives: (1) to validate the NOAA/DOE CWP computer code by means of a critical comparison between measured data and analytical design calculations; (2) to demonstrate the fabrication, deployment, and operational characteristics of a larger scale FRP CWP model. This document describes the development of a preliminary 1/3 scale CWP test article design which meets the above objectives. The main body of the report presents technical background for the development of the design, while the Appendix consists of a package of preliminary design drawings and specifications for the test pipe. This report also includes a preliminary instrumentation plan for a test of the CWP design.

25750 **(PB—83-221309) Ocean Thermal Energy Conversion cold water pipe at-sea test program status report. Design, fabrication, materials testing.** (Hawaiian Dredging and Construction Co., Honolulu (USA)). Feb 1982. Contract AI01-77ET20396. 181p. (DOE/NOAA/OTEC—52). NTIS, PC A09/MF A01.

This report describes the selection, testing, fabrication, and eventual deployment of a piping system for an OTEC platform.

25751 **(PB—83-221374) Potential inspection, maintenance and repair techniques for the OTEC (Ocean Thermal Energy Conversion) systems.** (Busby (R. Frank) Associates, Arlington, VA (USA)). Feb 1983. Contract AI01-77ET20396. 166p. (DOE/NOAA/OTEC—40; NOAA—83062005). NTIS, PC A08.

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One of the major post-installation considerations of the OTEC platforms is the performance of underwater inspection, maintenance and repair (IMR) during their 30-year design life. In order to assist in the conceptual development of an IMR program, this study was undertaken using the two OTEC candidate configurations as a baseline. The objectives of the study were: (1) conduct an inventory of underwater Non-Destructive Examination (NDE) devices including a description of their performance capabilities, dimensional data, the areas of the various structures where they are most applicable, and a narrative description of the level of performance attained to date; (2) and to conduct an inventory of NDE device deployment vehicles which also includes a description of their performance capabilities, dimensional data, areas of the platform where they are most applicable as now designed and a relative comparison of these vehicles as to their ability to deploy the devices described in (1) above.

25752 **(PB—83-221853) Study to develop an inspection, maintenance, and repair plan for OTEC (Ocean Thermal Energy Conversion) modular experiment plants. Final report.** (Brown and Root Development, Inc., Houston, TX (USA)). Apr 1980. Contract AI01-77ET20396. 429p. (DOE/NOAA/OTEC—65; NOAA—83062014). NTIS, PC A19/MF A01.

The inspection, maintenance and repair (IM and R) of the Ocean Thermal Energy Conversion (OTEC) Modular Experiment Plant (Pilot Plant) have been studied in two phases: Task I and Task II. Task I phase developed IM and R identification forms, identified requirements for routine and post casualty IM and R, and categorized and outlined potential procedures to perform IM and R activities. The efforts of the Task II phase have been directed to meet the following objectives: to provide feedback to the OTEC marine systems designs to assure that such designs reflect appropriate consideration of IM and R methods and unit costs, resulting in designs with reduced life cycle costs; to include technical information concerning OTEC IM and R possibilities to NOAA/DOE; to outline a basis in which the anticipated IM and R contributions to life cycle costs can be developed for any specific OTEC plant design; to identify IM and R methods within the state-of-the-art in the offshore industry; to determine the application of potential IM and R procedures for the commercial operation of OTEC 10/40 Pilot Plant(s); and input into the US government formulation of statutory and regulatory IM and R requirements for OTEC plants.

25753 **(PB—83-221945) OTEC (Ocean Thermal Energy Conversion) CWP (Cold Water Pipe) Laboratory Test Program. Materials Project Test Report.** (Science Applications, Inc., El Segundo, CA (USA)). Apr 1981. Contract AI01-77ET20396. 98p. (DOE/NOAA/OTEC—53; SAI—464-820-011-LA). NTIS, PC A05.

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Fiberglass sandwich wall structures emerged as leading candidates for the OTEC cold water pipe because of their high strength to weight ratio, their flexibility in selecting directional

properties, their resistance to electrochemical interaction, their ease of deployment and their relative low cost. A review of the literature established reasonable confidence that FRP laminates could meet the OTEC requirements; however, little information was available on the performance of core materials suitable for OTEC applications. Syntactic foam cores of various composition and density were developed and tested for mechanical properties and seawater absorption.

25754 **(PB—83-222059) OTEC (Ocean Thermal Energy Conversion) cold water pipe preliminary design study. Appendices to final report.** (TRW Systems and Energy, Redondo Beach, CA (USA)). 20 Nov 1979. Contract AI01-77ET20396. 350p. (DOE/NOAA/OTEC—44). NTIS, PC A15.

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This specification covers the fiberglass reinforced plastic cold water pipe (CWP) system for a 40 MW Ocean Thermal Energy Conversion modular demonstration plant. Included are requirements for materials, workmanship, delivery, assembly, inspection and quality assurance qualifications requirements for the pipe manufacturer and the contractor constructing the CWP system.

25755 **(PB—83-222109) OTEC (Ocean Thermal Energy Conversion) plant optimal design, fabrication and inspection specifications for OTEC ocean engineering systems.** Fjeld, S.; Stokke, K.; Roenning, B.; Mjelde, K.M.; Tvedt, L. (Norske Veritas, Oslo (Norway). Industrial and Offshore Div.). 30 Sep 1981. Contract AI01-77ET20396. 154p. (DOE/NOAA/OTEC—70). NTIS, PC A08/MF A01.

The purpose of the report is to give recommendations for possible modifications of the minimum technical requirements for the OTEC pilot plant to obtain optimal technical specifications considering total lifetime costs, lost income associated with production downtime, etc., without infringing on the minimum required safety level.

25756 **OTEC Ocean Engineering Technology Development.** Vadus, J.R. (National Oceanic and Atmospheric Administration, Rockville, MD). pp 547-559 of Ocean 82 conference report: Industry, government, education...partners in progress. Washington, DC; Marine Technology Society (1982). (CONF-820926—).

From Marine Technology Society and Geological Society of America conference on oceans; Washington, DC, USA (20 Sep 1982).

Ocean Thermal Energy Conversion (OTEC) is the principal ocean energy source under development by the US Department of Energy (DOE) because of its potential, state of development, and availability and access of the resource to the US. DOE has delegated the National Oceanic and Atmospheric Administration (NOAA) to carry out its OTEC Ocean Engineering Technology Development program. This program involves conducting research in critical, high technical risk areas in order to demonstrate technical and economical feasibility and develop a technical information base which can be used by industry to develop commercially viable systems. This program established preliminary baseline designs for floating and fixed systems; developed analytical computer models; conducted laboratory tests of scale models to calibrate analytical models; and is now preparing for sea tests of larger scale models for further validation of analytical models and improvement of baseline designs. This paper summarizes the technical accomplishments and major findings, mainly reported over the last year, and describes some of the remaining critical needs and the projects underway or planned to minimize the problems and associated risks. This paper covers the ocean engineering technology, viz., platforms, cold water pipe and sea water system, mooring and foundation systems and other areas related to the overall system integration aspects. The development of the electrical umbilical cable and bottom-mounted transmission cable has been managed directly by DOE and is integrated into the ocean engineering system. 19 references.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 25665, 26164, 26178, 26179, 26217

25757 **(DOE/BP—207) Determining stand-by tank losses from water heater storage tanks.** Gardner, C.M.; Biemer, J.R. (USDOE Bonneville Power Administration, Portland, OR. Div. of Resource Engineering). Dec 1983. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009720.

Many methods have been developed to evaluate the amount of heat loss from water heater storage tanks. This study compiles and reviews these methods. After taking into consideration the advantages and disadvantages of each, a preferred method is selected.

25758 **(DOE/CH/10122—11) SLR-PLUS Version 1.0 Reference Manual.** (ESG, Inc., Atlanta, GA (USA)). Feb 1984. Contract AC02-82CH10122. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84009180.

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The SLR-PLUS program predicts the heating benefits and subsequent cooling loads of passive solar energy systems. The heating performance of the passive systems is based on the method presented in Volume 2 of the Passive Solar Design Handbook using the expanded performance correlations given in Volume 3 of the Passive Solar Design Handbook. The cooling loads of passive systems are estimated using the method developed by A. Lau and reported separately by ESG, Inc. This reference manual documents the details of the calculation procedures and individual algorithms used to determine the passive system heating and cooling loads. Although it is not possible to present every calculation in detail, sufficient information is provided to show the proper interaction between the various program input parameters. The accuracy of the calculation procedures and of the intermediate algorithms are given where possible. The source code listing is included as the appendix.

25759 **(DOE/CH/10122—24) Passive solar residential design and construction projects in the southeastern United States. Technical summary and final report.** (ESG, Inc., Atlanta, GA (USA)). Mar 1984. Contract AC02-82CH10122. 105p. NTIS, PC A06; 3; GPO Dep. Order Number DE84010658.

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This document summarizes the Passive Solar Residential Program efforts conducted in the southeastern United States under the sponsorship of the US Department of Energy. The work was focused through a series of design projects, many of which were carried through the construction phase by participating local builders. This document provides information on the design process, the major projects, and shows typical home plans and the general characteristics of the passive solar systems. It contains case studies for six representative projects and brief plan sheets for 27 designs.

25760 **(DOE/CH/10122—25) Simplified method for estimating the cooling loads of passive solar systems.** (ESG, Inc., Atlanta, GA (USA)). Jan 1984. Contract AC02-82CH10122. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84009474.

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This report presents a simplified procedure for estimating the auxiliary cooling load caused by passive solar heating systems. The primary assumption is ideal ventilation such that no auxiliary cooling is required when ambient temperature is below the thermostat setting. Factors based on bin temperature data are used to account for the portion of solar gain which occurs during overheated periods. A nomogram and data for annual analysis of solar aperture cooling loads are presented. Methods of accounting for shading and movable insulation are also discussed. An example for Atlanta shows that certain passive solar systems can result in high cooling loads, which may even be great enough to offset the heating load reduction. Of course, this usually requires that a passive system, such as a sunspace, be designed so that it can be thermally de-coupled from the structure during the summer months. Other controls methods are possible and should be considered for application in temperate climates.

25761 **(DOE/CS/30569—33) Performance of a drain-back solar heating and hot water system with auxiliary heat pump. Final report.** Karaki, S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Mar 1984. Contract AC03-81CS30569. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010824.

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The principal objective of the project was to test and evaluate the BNL collectors in a space heating system. When the BNL collectors delaminated under stagnation conditions, they were replaced with the Chamberlain collectors which were previously used on solar house III, and tests were continued to evaluate performance of a drain-back system. Results leading to the following conclusions are discussed. (1) The Chamberlain collectors have deteriorated in performance compared to previous seasons. Where daily efficiency of 41% were attained in 1978 to 1979 and 1979 to 1980, efficiency was 37%. System efficiency of 29% compares to 30% in prior years. (2) Solar contribution to DHW heating is low, and is probably the result of the artificially imposed load profile and the low recovery rate of the double-wall heat exchanger. (3) System efficiency can be improved by reducing thermal losses from storage.

25762 **(DOE/CS/32137—T1) California State Office Building - Site III: project overview.** (California, State of, Sacramento (USA)). Feb 1984. Contract FC03-78CS32137. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009418.

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The Acceptance Test Plan and the Operation Manual for the solar, heating and air conditioning systems at Site III is presented. The solar system which serves as the focal point of the building design is a natural complement to a structure conceived with full attention to energy conservation. The building, a subterranean, solar-powered structure containing 237,000 square feet of total space, is designed for the Employment Development Department of the State of California. The solar array consists of 30 modular collectors with a concentration ratio of 24/1. There are 28 modules 50 feet long by 9 feet wide and two modules 42 feet long by 9 feet wide and they contain 48 one foot wide extruded aluminum reflector blades. The receiver is a steel pipe with a special black chrome coating to enhance the absorption of solar heat. The steel pipe is supported by an aluminum housing suspended about eight feet above and parallel to the reflector blades. The modules are connected in a continuous 300 foot long row. The solar system is comprised of three solar loops, which can operate independent of each other, if required. The high temperature system is designed to provide high temperature water within the shortest time possible by incorporating a separate loop. The solar loop operates between temperatures of 120°F and 130°F. Between 120°F to 200°F solar heat is used directly for space heating and domestic hot water purposes. At 200°F to 300°F the solar hot water is used to drive the absorption machine for space cooling or put into the high temperature storage tank for later use. The objective of the acceptance test is to determine whether the system, as installed, meets design requirements.

25763 **(DOE/CS/32378—T2-Vol.1) Maryland National Capital Park and Planning Commission, Shady Grove Solar Office Building. Volume 1. Final technical report.** (Maryland National Capital Park and Planning Commission, Silver Spring (USA)). Oct 1982. Contract AC03-76CS32378. 92p. NTIS MF A01. Order Number DE84001026.

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The Shady Grove Solar Office Building is located in Gaithersburg, Maryland, a suburb of Washington, DC. The 3500 square foot structure was designed from the ground up with solar energy as a primary consideration, incorporating both active and passive solar energy collection and storage. The active solar system is designed for heating only. It was determined in the initial design stage that the extra cost of heat exchangers, special piping and pumps would not be justified for DHW considering the small amount of hot water demand in the office. Solar energy is collected by 1500 ft^2 of KTA tubular solar collectors, stored in a 3000 gallon steel tank, and distributed throughout the building by three water to air heat exchangers in three air handlers. One additional fan coil unit is used for demonstration purposes in the lobby area. The passive system consists of 340 square feet of double glazed windows, oriented true south. This volume includes a narrative description of the building and solar energy system, specifications for the solar energy equipment, acceptance test plans, and photos of the completed project.

25764 **(DOE/CS/32378—T2-Vol.2) Maryland National Capital Park and Planning Commission Shady Grove solar office building. Volume 2. Final technical report.** (Maryland National Capital Park and Planning Commission, Silver Spring (USA)). Oct 1982. Contract AC03-76CS32378. 126p. NTIS MF A01. Order Number DE84001604.

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This document, volume two of two is intended to be used by on-site technical and maintenance personnel for the routine operation of the solar energy system. It includes submittals by the contractors, specifications, drawings and other material useful for operating and maintaining the system. Although a list of procedures which can be used to start up the system each fall is included, it is not intended as a step-by-step instruction book, but rather a compendium of technical information on components and subsystems of the solar energy system. This volume is organized in sections with general operating procedures followed by a section for each important subsystem or component. For subsystems which have detailed operating or maintenance procedures, those procedures are found in that particular section along with the technical submittals and specifications. For example, instructions for calibrating the differential thermostats will be found in the Controls section, along with wiring diagrams and product information.

25765 **(DOE/CS/32382—T3) Solar water-heating system refurbishments: Ingham County Geriatric Medical Care Facility. Final technical report.** (Manyam and Associates, Inc., Lansing, MI (USA)). Jul 1983. Contract AC03-76CS32382. 45p. NTIS, PC A03; 3; GPO Dep. Order Number DE84009200.

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The step-by-step procedure for the refurbishment project for the medical care facility is detailed. The Wyle Laboratories' solar collector test report is included in the apendix.

25766 **(DOE/CS/32382—T4) Solar water-heating system for the Ingham County geriatric medical care facility, Okemos, Michigan. Operational and maintenance instruction manual.** (Manyam and Associates, Inc., Lansing, MI (USA)). 29 Jul 1983. Contract AC03-76CS32382. 266p. NTIS, PC A12; 3; GPO Dep. Order Number DE84009163.

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The objectives of the Ingham County Solar Project include: the demonstration of a major operational supplement to fossil fuels, thereby reducing the demand for non-renewable energy sources, demonstration of the economic and technical feasibility of solar systems as an important energy supplement over the expected life of the building, and to encourage Michigan industry to produce and incorporate solar systems in their own facility. The Ingham County solar system consists of approximately 10,000 square feet of solar collectors connected in a closed configuration loop. The primary loop solution is a mixture of water and propylene glycol which flows through the tube side of a heat exchanger connected to the primary storage tank. The heat energy which is supplied to the primary storage tank is subsequently utilized to increase the temperature of the laundry water, kitchen water, and domestic potable water.

25767 **(DOE/CS/35195—T1) Solar energy system, Baltimore County Jail, Towson, Maryland. Final report.** (Beck (Mark) Associates, Inc., Columbia, MD (USA)). 20 Feb 1984. Contract FC03-78CS35195. 242p. Mark Beck Associates, Inc., Three Lakefront North, 5570 Sterrett Place, Columbia, MD 21044.

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The Baltimore County Jail solar system incorporates four independent piping systems: (1) glycol loop system; (2) solar water system; (3) chilled water system; and (4) domestic cold and hot water system. This final report includes: final system description; construction costs; as-build drawings; acceptance test; control drawings; and product information.

25768 **(DOE/CS/69104—1) Solar home heating in Michigan.** (Michigan Energy Administration, Lansing (USA)). 1984. Contract FG45-80CS69104. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010430.

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This booklet presents the fundamentals of solar heating for both new and existing homes. A variety of systems for space heating and household water heating are explained, and examples are shown of solar homes and installations in Michigan.

25769 **(DOE/CS/84055—T1) Solar drying. Final report.** Helmer, W.A. (Southern Illinois Univ., Carbondale (USA). Dept. of Thermal and Environmental Engineering). 1981. Contract FG02-80CS84055. 67p. NTIS, PC A04; 3; GPO Dep. Order Number DE84008221.

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The following is made concerning the progress of this research indicating that the objectives of this study have been achieved: (1) two-dimensional computer model has been developed to predict the solar drying characteristics of a moist material; and (2) the model has been verified for two experimental cases where coal was dried using solar energy.

25770 **(DOE/R5/10330—2) Rotating-prism, movable-mass solar energy system. Final report.** (Solar Energy Engineering, Poland, OH (USA)). 6 Apr 1984. Contract FG02-81R510330. 57p. NTIS, PC A04; 3; GPO Dep. Order Number DE84008632.

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The device development of a rotating-prism, movable-mass, solar energy storage system is described in the report. The accompanying 22 minute, 35 mm slide show with cassette recorded narration is recommended as the best way to become familiar with the concepts and development work. The system is made of rectangular prisms which look like "fat" doors that contain energy storage material, specifically water and phase change media, for collecting, storing, and delivering solar energy. One side is the absorptive/radiative surface and the other large surface is insulated. A set of these prisms make up a wall section closely resembling a Trombe wall with insulation on one side. The unique feature is the relative position of the storage mass and insulation is changed by rotating the entire prism, not just moving the insulation. The apparently "passive" system thus can be "actively" controlled thus improving performance over the traditional Trombe wall. The many modes of operation are described. The device development included the research, design, and eventual construction of rotating prism storage assemblies. It included the design and development of a unique new air seal gasket. Actual prisms were installed to evaluate and demonstrate the viability of the concept.

25771 **(DOE/R5/10330—T1) Rotating-prism, movable-mass, solar energy system. A slide show with accompaning cassette narration describing a device development.** (Solar Energy Engineering, Poland, OH (USA)). 6 Apr 1984. Contract FG02-81R510330. 13p. TIC, PO Bx 62, Oak Ridge, TN 37831.

25772 **(DOE/R7/01154—T1) Passive solar collector project. Final report.** Smith, J.W. (Smith (John W.), Overland Park, KS (USA)). 1982. Contract FG47-80R701154. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84007850.

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This proposal intends to develop a solar collector design that will fill the gap between complex active solar collectors and the passive dwelling design. The collector design is intended for (but not limited to) residential use, with the do-it-yourselfer in mind. The collector itself consists simply of a moulded 4 ft x 6 ft transparent plastic tray. A sunny location on the side of the house is selected, intake and outlet ducts are cut through the wall. The wall is then painted a dark color, and the collector panels are installed over the ducts. This collector takes advantage of incident solar radiation, heating air by convection. The collector output is intended to supplement the existing space heating system, thus conserving fossil fuels. The final report on the completion and performance of this project is presented.

25773 **(DOE/R7/01162—T1) Underground-desiccant cooling system.** Finney, O. (Finney (Oliver), Lawrence, KS (USA)). Oct 1982. Contract FG47-80R701162. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010014.

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The Underground-Desiccant Cooling System relies on the successful coordination of various components. The central feature of the system is a bed of silica gel which will absorb moisture from house air until the gel has become saturated. When this point has been reached, the silica gel must be regenerated by passing hot air through it. For this project, the hot air is produced by air-type solar collectors mounted on the roof and connected with the main air-handling system by means of ducts attached to the outside of the house. As the air is dehumidified its temperature is raised somewhat by the change of state. The dried but somewhat heated air, after leaving the silica gel bed, passes through a rock bin storage area and then past a water coil chiller before being circulated through the house by means of the previously existing ductwork. The cooling medium for both the rock bin and the chiller coil is water which circulates through underground pipes buried beneath the back yard at a depth of about 10 to 12 ft. When the silica gel is being regenerated by the solar collectors, house air bypasses the desiccant bed but still passes through the rock bin and the chiller coil and is cooled continuously. The system is designed for maximum flexibility so that full use can be made of the solar collectors. Ducting is arranged so that the collectors provide heat for the house in the winter and there is also a hot-water capability year-round.

25774 **(DOE/R7/01201—T1) Solar heating for indoor community swimming pool.** (Clarinda, City of, IA (USA)). 1984. Contract FG47-81R701201. 44p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010102.

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This project demonstrates the application of solar technology to an existing public indoor swimming pool. An application makes use of a new type of solar collector material called SolaRoll. The pool water is cycled through collectors made of the material mounted on the pool's dome roof, reducing reliance on natural gas and fuel oil. Approximately 60% of the energy to heat pool water will be provided. The specific objective of the project is to reduce reliance on natural gas and fuel oil consumption used to heat the community's pool and in so doing provide an example for residential applications.

25775 (LBL—13500, pp 2.2-2.8) **Passive research and development.** Kammerud, R.C.; Place, J.W.; Martin, M.R.; Berdahl, P.H.; Elmer, D; Anderson, B.; Bauman, F.S.; Carroll, W.L.; Gadgil, A.J.; Mertol, A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The passive program at Lawrence Berkeley Laboratory is directed at theoretical and experimental investigations of the thermal performance implications of passive design strategies, with emphasis on passive and hybrid cooling of commercial buildings. To date, the emphasis has been on the development and testing of techniques for predicting (1) the resource for passive systems and (2) a building's response to that resource. In this context, the term resource implies the naturally occurring potentials of the environment to provide heating and lighting (as a result of solar gains) and cooling (via radiation to the sky, conduction to the ground, and ventila-

tion/evaporation with ambient air). These potentials are being investigated in projects in the following areas: convection and natural ventilation, radiative cooling, natural lighting, passive building energy analysis, and passive domestic hot water. Accomplishments and future plans in each of these areas are described.

25776 (LBL—13500, pp 2.8-2.15) **Active solar cooling.** Wahlig, M.A.; Dao, K.; Warren, M.L.; Rasson, J.E.; Armer, R.A.; Angerman, H.; Heitz, A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

This project has three maor tasks: (1) research and development (R and D) of improved absorption cycles for active solar cooling and heating, (2) performance and economic anlaysis of active solar cooling and heating systems to establish cost/performance goals for the R and D program, and (3) technical support activities for the active solar cooling program.

25777 (LBL—13500, pp 2.23-2.24) **Support for SOLERAS solar cooling engineering field tests.** Wahlig, M.A.; Salter, F.H. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

LBL provides technical consulting and management services to support the Solar Energy Research Institute's overall management of the SOLERAS Solar Cooling Engineering Field Tests. These field tests are part of the Urban Solar Applications Program within the Joint United States - Saudi Arabian Program for Cooperation in the Field of Solar Energy (SOLERAS).

25778 (LBL—13500, pp 2.25-2.28) **LBL building 71 solar cooling project.** Salter, F.H. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The purposes of this program are to demonstrate the Federal Government's confidence in the solar industry and to stimulate growth and technical improvements in solar technology through the installation and demonstration of a variety of commercially applicable solar energy systems in buildings owned or occupied by the Federal Government. The program provides technical and financial assistance through interagency agreements to federal agencies for design, acquisition, construction, and installation of solar heating and cooling equipment projects.

25779 (LBL—13500, pp 2.29-2.31) **Diffractive solar collection systems.** Evans, D.B.; Hunt, A.J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

During the past year, the LBL Solar Group has been investigating diffractive collector concepts as part of an overall program to study the optical properties of matter of small dimensions. This diffractive work can be divided into three areas. The first area involves basic studies of the general characteristics of holographic optical elements (HOE's) when considered for solar applications. The second area of the program has centered around more detailed analytical calculations of the performance of specific concentrating HOE's. An ultimate goal is to develop a set of computer-assisted design tools for solar holographic systems. The final area of the research has been the development of a complementary experimental program. This experimental effort not only provides validation of analytical techniques but also has been geared toward developing laboratory techniques for characterizing the true efficiency of HOE's in solar applications.

25780 (NMERDI—2-71-4519) **Eighth national passive solar conference. Final report.** Owen, A.; Zee, R. (New Mexico Solar Energy Association, Santa Fe (USA)). Dec 1983. 64p. NMERDI, 457 Washington, SE, Suite M, Albuquerque, NM 87108.

The Eighth National Passive Solar Conference was held near Santa Fe, New Mexico at the Glorieta Conference Center on September 5 to 11, 1983. Nearly 900 people from all across the nation and the world attended the conference. Close to 200 technical papers were presented, 50 solar product exhibits were available; 34 poster sessions were presented; 16 solar workshops were conducted; 10 renowned solar individuals participated in rendezvous sessions; 7 major addresses were delivered; 5 solar home tours were conducted; 2 emerging architecture sessions were held which included 21 separate presentations; and commercial product presentations were given for the first time ever at a national passive solar conference. Peter van Dresser of Santa Fe received the prestigious Passive Solar Pioneer Award, posthumously, from the American Solar Energy Society and Benjamin T. Buck Rogers of Embudo received the prestigious Peter van Dresser Award from the New Mexico Solar Energy Association. This report reviews conference organization, attendance, finances, conference evaluation form results, and includes press coverage samples, selected conference photos courtesy of Marshall Tyler, and a summary with recommendations for future conferences. The Appendices included conference press releases and a report by the New Mexico Solar Industry Development Corporation on exhibits management.

25781 (NMERDI—2-71-4603) **Development and manufacturing of a more cost-effective heat pipe solar water heater. Final report.** Feldman, K.T. Jr. (Energy Engineering, Inc., Albuquerque, NM (USA)). Feb 1984. 48p. NMERDI Information Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108.

A one year research and development project was conducted with NMERDI and Energy Engineering, Inc. (EEI) support to improve the design, manufacturing, testing, certification, shipping and installation of the heatpipe (tm) Passive Solar Water Heater. The objectives of the project were to develop a more cost-effective heatpipe (tm) system and the machines and manufacturing processes needed to produce it in the EEI Albuquerque plan. The project included redesign of the collector frames and mounting hardware to use aluminum extrusions, redesign of the tank cover to use molded fiberglass, new polisocynaurate foam insulation for the tank covers, a new heat pipe extrusion and welding process, new shipping and crating techniques, and new system data. The test data indicates that the heatpipe (tm) system efficiency is equal to the best active systems and is significantly better than most passive solar DHW systems.

25782 (PB—84-151992) **Feasibility study for the application of solar energy to proposed facilities of Maryland State Highway Administration.** Miller, J.H. (Maryland State Highway Administration, Baltimore (USA)). 4 Mar 1983. 100p. NTIS, PC A05/MF A01.

The contemporary and future challenges to energy utilization must recognize and cope with freshly perceived, finite limits to the available supply of fuels. These limits to supply result in a steady pattern of unit cost increases. Coping takes many forms, including more efficient conversion, loss reduction, waste energy recovery, and increased use of alternate energy sources. One of these alternate sources is solar energy. The utilization of solar energy is governed by a completely different body of rules and characteristics. The high cost of collection and utilization systems makes it mandatory to limit demand. This is balanced by a source of energy which, although irregularly available, has a low intensity, has no cost and no finite limit on supply. This report will analyze the feasibility of utilizing solar energy in certain SHA facilities.

25783 (SERI/TP—252-2170) **Modeling of solid-side mass transfer in desiccant particle beds.** Pesaran, A.A.; Mills, A.F. (Solar Energy Research Inst., Golden, CO (USA); Auckland Univ. (New Zealand)). Feb 1984. Contract AC02-83CH10093. 10p. (CONF-840402—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004436.

From 6. annual ASME Solar Energy Division technical conference; Las Vegas, NV, USA (10 Apr 1984).

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A model is proposed for heat and mass transfer in a packed bed of desiccant particles and accounts for both Knudsen and surface diffusion within the particles. Using the model, predictions are made for the response of thin beds of silica gel particles to a step change in air inlet conditions compared to mental results. The pre-

dictions are found to be satisfactory and, in general, superior to those of pseudogas-side controlled models commonly used for the design of desiccant dehumidifiers for solar air conditioning application.

25784 **Heat storage and distribution inside passive solar buildings.** Balcomb, J.D. (Los Alamos National Laboratory, NM). pp 547-561 of Passive and low energy architecture. Yannas, J.; Bowen, A. Oxford, England; Pergamon Press (1983). (CONF-830630—).

From International conference on passive and low energy architecture; Chania, Crete, Greece (27 Jun 1983).

Passive solar buildings are investigated from the viewpoint of the storage of solar heat in materials of the building: walls, floors, ceilings, and furniture. The effects of the location, material, thickness, and orientation of each internal building surface are investigated. The concept of diurnal heat capacity is introduced and a method of using this parameter to estimate clear-day temperature swings is developed. Convective coupling to remote rooms within a building is discussed, including both convection through single doorways and convective loops that may exist involving a sunspace. Design guidelines are given.

25785 **High-temperature solar pyrolysis of coal.** Beattie, W.H.; Berjoan, R.; Coutures, J.P. (University of California, Los Alamos National Laboratory, Los Alamos, NM). *Solar Energy;* **31**: No. 2, 137-143(1983).

Subbituminous coal from Western United States was pyrolyzed by directly exposing 50 mg powdered samples to concentrated solar radiation. It was found that exposure to flux levels > 200 W/cm^2 for 12.5 s devolatilized 51 per cent of the coal. At flux levels between 100 and 200 W/cm^2 devolatilization was slightly less. Gas yield was a maximum of 31 mmol/g coal at a flux of 100 W/cm^2 and decreased slightly with increasing flux. Gas yields were more than twice as great as those obtained by a laser technique developed to simulate solar pyrolysis. In experiments with spectral cut-off filters there was no effect due to changing the wavelength distribution of sunlight.

25786 **Attached-sunspace designs: A nationwide economic appraisal.** Roach, F.; Kirschner, C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico). *Alternative Energy Sources;* **8**: 3-42(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Performance estimates for attached-sunspace passive solar heated residences have recently been incorporated into the LASL/UNM EASE III model. These estimates are used to analyze the economic performance of a fixed dimension sunspace design when attached to a pre-existing single family residential unit. The sunspace is a passive design which can be easily and effectively adapted to a retrofit situation. Several key parameters are carefully evaluated for the sunspace retrofit design. These include loan or mortgage terms, ownership period, resale potential and competing conventional fuel prices. General economic and design parameters are combined in a variant of life cycle costing to evaluate the feasibility of both owner-built and contractor-built attached sunspaces for 220 regions in the contiguous United States. This evaluation is made for two conventional fuel types--natural gas and electric resistance--and for three resale values--0%, 100%, and 200%. Results show that the prospect for conventional fuel displacement through retrofit of attached sunspaces is very good with the design's economic performance enhanced in regions with expensive conventional fuel alternatives.

25787 **The economics of solar, geothermal and conventional space heating.** Garrett-Price, B.A.; Bloomster, C.H.; Fassbender, L.L. (Pacific Northwest Laboratory, Richland, Washington). *Alternative Energy Sources;* **8**: 43-50(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The costs of residential heating using conventional, solar and geothermal energy were calculated for a number of locations throughout the United States using life-cycle costing methodology. Using these costs, regions and applications are identified which show the most promise for near-term commercialization of geothermal and solar energy. Equally important, areas and applications are depicted which are not likely to be promising for solar or geothermal heating in the near-term. The regions showing the most immediate promise for solar heating occur in central Nevada, Utah and Colorado. These regions are characterized by high levels of insolation and high annual heating degree-days. Geothermal urban district heating currently appears to be an economic option for providing space heat in at least six locations: Reno, Nevada; Idaho Falls, Boise and Twin Falls, Idaho; Helena, Montana; and Klamath Falls, Oregon. These areas are characterized by high annual heating degree-days, high resource temperatures, and short transmission distances. In the near-term, conventional heating will continue to be most economic: (1) in the South (where annual heat demand is low), (2) in the Northeast and Midwest (where insolation levels are low and where known geothermal resources are not yet available), and (3) in the Pacific Northwest coastal region (where low-cost electricity is available).

25788 **A data acquisition and instrumentation system for a solar industrial process heat installation.** Pytlinski, J.T.; Conrad, G.R.; Munding, P. (New Mexico State University, Las Cruces, New Mexico). *Alternative Energy Sources;* **2**: 397-413(Dec 1980). (CONF-801210—). Contract AC03-78CS32223.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

An instrumentation and data acquisition system for solar steam generation in a refinery is described. The system monitors the performance of the solar installation at the Southern Union Refinery in Hobbs, New Mexico. The refinery processes 36,000 barrels of crude oil per stream day. The solar system uses a total collector area of 936 m^2 (10,080 ft^2). The collectors daily thermal output is 16.46 x 10^6 Joules/m^2 (1450 Btu/ft^2). A description of the solar system and the refinery operation is given. The instrumentation monitoring the solar installation's thermal, electrical and environmental parameters consists of 42 sensors and a data acquisition system (ODAS). The ODAS has the capability for on-site data recording, reduction and display and is equipped with a power backup. The data logger Autodata Ten/10 is programmed to process the data into daily and weekly summaries of solar system performance. The results of a sensitivity study of the solar system's performance parameters and the mathematical expressions derived for the parameters are presented.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 25713, 25770, 25771

25789 (ANL—83-55, pp 89-91) **Solar energy.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The solar activities in the Chemical Technology Division (CMT) are part of an overall one million dollar Applied Solar Energy Program at ANL. The ANL program includes work on collectors (CMT), thermal energy storage (CMT, Engineering, Components Technology, Materials Science and Technology), and solar ponds (Components Technology). The CMT solar work for 1982 is summarized.

25790 **(BMFT-FB-T—83-227) Developing of practical methods for the determination of the stagnation temperature and the durability of solar collectors.** Wenzel, H.; Hoess, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 202p. (In German). NTIS (US Sales Only), PC A10 MF/A01. Order Number DE84750924.

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Stagnation temperatures should be used as a help to criticize solar collectors. The tests were made with 6 solar collectors outdoors as well as indoors. In the course of this research work a solar simulator was built with an area of 2,5 x 2 m. The outdoor measured stagnation temperatures and the exponent for the interpolation and extrapolation to other solar radiations were varying within the

year up to 10%. By the permanent variations of the absorber temperatures at stagnant circulation pump the air between the collector panel assembly and the ambient air will be exchanged 20 times within 12 months. In climatic chamber tests there was demonstrated by weighing that solar collectors absorb the quantity of water from 10 to 500 g/(m², week) by vapor diffusion depending on design and material of the enclosure. It is useful to take 2 solar collectors for comparing aging tests. One collector will be aged naturally or artificially, the second should be stored in a dry room until the next comparing test. By maintaining a constant enclosure temperature the anual variations can be eliminated. It is supposed that this method will increase the accuracy of measurements of pyranometer, too.

25791 **(DOE/ET/00078—T1) Study of stabilized CuO/Al solar absorbers. Final report.** Braundmeier, A.J. Jr. (Southern Illinois Univ., Edwardsville (USA). Dept. of Physics). Mar 1984. Contract FG02-79ET00078. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009339.

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The purpose of the research performed was the study of photothermal solar absorbers. These absorbers were of a tandem design where CuO was the absorbing material for the visible wavelengths and Al was the material used to enhance the near-infrared reflectance. The goal was then to study the properties of both thermally prepared and sputter-deposited CuO; and to perform thermal annealing studies of the solar absorber tandem configurations. The normal incidence transmittance and reflectance of a 3850 A thick thermally oxidized CuO film are shown. The CuO exhibits high absorptance in the visible but the absorptance decreases dramatically beyond 0.8 μm. In the near-infrared the CuO behaves as a high refractive index material with a low absorption coefficient. This feature makes it useful as a solar absorber. The normal incidence transmittance and reflectance of a 5570 A thick sputtered CuO film were measured. Except for a lowered transmittance in the near-infrared, the curves closely resemble those of thermal CuO. The lowered transmittance is due to increased absorptance by the greater film thickness. The studies of CuO and CuO/metal tandem solar absorber configurations have shown that there are still some major problems associated with tandem designs. Because a single material cannot provide the broad-band optical performance needed for an efficient solar absorber, two different materials in tandem are necessary.

25792 **(DOE/ET/20265—T2) Concentrating solar collector: technical note.** (Acurex Corp., Mountain View, CA (USA). Aerotherm Div.). 1984. Contract AC04-77ET20265. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007817.

The Acurex Model 3002 concentrator is a reflecting parabolic trough collector designed to heat liquids or gases to temperatures between 140°F and 350°F. The cost effectiveness, performance, reliability, and technical description of the collector are presented.

25793 **(DOE/JPL—1060-64) JPL tests of a LaJet concentrator facet.** Dennison, E.W.; Argoud, M.J. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Nov 1983. Contract AT04-81AL16228. 16p. (JPL-PUB—83-92). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008507.

A LaJet Energy Company (LEC) concentrator facet, 60 in. in diameter, was tested for imaging quality at the Jet Propulsion Laboratory using two methods: (1) autofocus tests with a point source of light at the facet's radius of curvature, and (2) tests with the sun close to the horizon as a distant source. These tests of the LaJet facet indicate that all of the solar image reflected by an LEC 460 solar concentrator made of like facets should fall within a 9-in. aperture if the outer facets are carefully adjusted. Such a concentrator would have acceptable performance, but complete evaluation must be made with an assembled concentrator.

25794 **(EIR—462) EIR solar heating plant OASE. Pt. 2.** Wiedemann, K.H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1983. 24p. (In German). NTIS (US Sales Only), PC A02 MF/A01. Order Number DE84750946.

For a corrosion surveillance program of the EIR solar heating unit OASA, the coolant of the flat collector circuit has been controlled and material samples mounted in a circuit by-pass have been tested periodically. The results of the first 13 months have been dealt with an EIR-Report Nr. 457. This report presents the results of the coolant tests as well as the material samples tests after 33 or 25.5 months of surveillance, respectively. At the start of the program the composition of the coolant was 65 Vol.% deionized water, 35 Vol.% ethyleneglycol, and 15 g/l Inhibitor. This composition remained practically constant. The metal contents of the coolant samples show large differences, because of deposits of metal containing precipitates, the amount of them being temporal and locally different; psub(H) and electrical conductivity remained practically constant. Therefore, corrosion in the circuit cannot be recorded by psub(H) or electrical conductivity readings or by chemical analysis of coolant samples. The greatest quantity of the metal loss occured during the first year and increased only slightly during the second year. Pitting corrosion has not been observed on any material.

25795 **(FRNC-TH—1402) Preparation and characterization of black molybdenum films: application to solar energy photothermic conversion.** Karbal, S. (Montpellier-1 Univ., 34 (France)). Jun 1982. 143p. (In French). NTIS (US Sales Only), PC A07. Order Number DE84751351.

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The main and general points on selective coatings are reviewed. Optical properties (absorptivity, reflectivity, emissivity) of black chrome and black molybdenum are studied. Then the method of deposition in vapor phase and the equipment constructed are described. This paper deals also with the physical and optical characterization of the prepared black molybdenum films. A possible application to black molybdenum alone with other materials (such as tin oxide) in absorption-reflection pairs is finally presented.

25796 **(FRNC-TH—1422) Characterization of flat-plate air solar collectors.** Rampazzo, D. (Paris-6 Univ., 75 (France)). Oct 1982. 316p. (In French). NTIS (US Sales Only), PC A14; 03. Order Number DE84751356.

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The main characterization parameters are presented, and, a simple and rigorous, reduced energy characterization is defined. Models used for the resolution of equations where solutions are analytical functions are developed. The results of experimental tests on collectors complying with the calculation productions are analyzed. The applicability of the reduced energy characterization is studied. The thermal exchange with the air heat conductors which allows interesting collector to be suggested is studied.

25797 **(NMERDI—2-69-2107) Demonstration of a solar gel pond. Final report.** Wilkins, E.S. (New Mexico Univ., Albuquerque (USA). Dept. of Chemical and Nuclear Engineering). Apr 1984. 330p. NTIS, PC A15/MF A01. Order Number DE84901098.

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The purpose of this work was to demonstrate the gel pond concept in a small pond, to document performance and to study various aspects of this new technology. The pond and the surrounding ground was instrumented with thermocouples, and meteorological parameters were monitored. Insofar as comparisons could be made, the gel pond was superior to a similar salt gradient pond. Surface heat losses were considerably less, and stability problems of course nonexistent. Existing models of stratified ponds were reviewed and both steady state and unsteady state model for the gel pond were constructed. Prediction of these models agreed well with actual experimental data from the gel pond. Possible use of phase change materials to enhance heat storage in the gel pond was investigated. Both calculation and laboratory experiments for selected materials were performed; it was concluded that the present cost of the best material does not justify their use at present. Physical properties of various gel material were measured (density, specific heat, thermal conductivity, life time, and optical transmissivity). In general the physical properties of gel were similar to that of water. Optical transmissivity was also monitored out doors in a

pond. A restrictive cost-benefit analysis was conducted comparing the salt gradient and the gel pond in the same location for varying location, load, size. It is demonstrated that the gel pond energy cost is lower than that from salt gradient ponds.

25798 **(NP—4900813) Directory of SRCC certified solar collector ratings: supplement to Fall 1983 edition.** (Solar Rating and Certification Corp., Washington, DC (USA)). 1983. 39p. SRCC, 1001 Conn. Ave., NW Suite 800, Washington, DC 20036.

The solar collector thermal performance ratings contained in this Directory Supplement provide both the manufacturer and the solar consumer with a means for making informed comparisons between collectors over a broad range of applications. The thermal performance rating figures for collectors as published in the directory are calculated from test data generated from either ASHRAE 93-77 or ASHRAE 96-1980 test standards (SRCC Standard 100-81). These rating numbers represent the all day energy output of a collector and are expressed in terms of thousands of Btu's (British Thermal Units) per Day per Panel. The directory is divided into four sections representing the main generic types of collector panels. Each entry contains not only the thermal performance ratings, but collector material descriptions, fluid capacity, tested flow rate, maximum recommended flow rate, operating temperature and pressure as well as an efficiency equation, incident angle modifier, and Y-intercept and slope values.

25799 **A numerical model to describe the layer behavior in salt-gradient solar ponds.** Meyer, K.A. (Los Alamos National Laboratory, Los Alamos, NM). *Journal of Solar Energy Engineering;* **105**: No. 4, 341-347(Nov 1983).

A numerical model has been developed to describe the time-dependent behavior of the interfaces between the convecting and nonconvecting regions of a salt-gradient solar pond. Salinity and temperature profiles, as a function of time, are also determined by the model. The model utilizes empirical correlations from the oceanographic literature that describe the heat and salt fluxes across the interfaces. The model also contains a treatment of entrainment caused by wind-generated turbulence. Agreement was found of the calculated behavior with observations made on laboratory-scale solar pond simulation experiments. The model is used to determine pond performance under various operating conditions.

25800 **Effects of friction and extraction on the stability of solar ponds.** Cha, Y.S.; Sha, W.T.; Soo, S.L. (Analytical Modeling Section Components Technology Division, Argonne National Laboratory, Argonne, IL). *Journal of Solar Energy Engineering;* **105**: No. 4, 356-362(Nov 1983).

Experimental results were compared to theoretical stability criteria of a salt gradient solar pond. Cellular motion in the nonconvective layer may be caused by instability. Extension of stability criteria suggests use of stabilizing barriers via friction. Stability of longitudinal extraction assures optimum availability of energy from a solar pond.

25801 **Simulation of a solar pond with a stratified storage zone.** Newell, T.A. (Department of Mechanical and Industrial Engineering, University of Iinois at Urbana-Champaign, Urbana, IL). *Journal of Solar Energy Engineering;* **105**: No. 4, 363-368(Nov 1983). Contract FG02-81AF92002.

Numerical simulation results are presented which compare performances between a conventional solar pond and a proposed solar pond configuration. The proposed pond maintains a stratified storage zone below the lower convecting zone of a pond. Addition of a stratified storage zone is shown to have two general results. First, ground losses are minimized, and second, higher process temperature levels can be accommodated. Additionally, the proposed configuration may result in a reduction of pond investment cost.

25802 **In Situ measurement of solar pond density profiles.** Langeliers, J.; Stojanoff, C.G. (University of Nevada System, Desert Research Institute, Energy Systems Center, Boulder City, NV). *Journal of Solar Energy Engineering;* **105**: No. 4, 380-382(Nov 1983).

The stability of a solar pond is critically dependent upon the maintenance of a suitable vertical density gradient, but rapid, inexpensive methods of profiling the density gradient do not presently exist. A method for obtaining in situ density profiles through measurement of hydrostatic pressure differential is described and investigated. Design parameters and experimental results are presented for a prototype instrument.

25803 **Experimental performance characterization of line-focus collectors.** Lukens, L.L. (Sandia National Laboratories, Albuquerque, NM). *Journal of Solar Energy Engineering;* **105**: No. 4, 408-412(Nov 1983).

To be able to predict accurately the performance of a specific solar collector in a given environment, its performance must first be characterized over the range of conditions under which the collector is expected to operate. In the present paper, collector performance models are developed for parabolic trough and compound-parabolic type concentrating collectors. Experimental collector performance data from Sandia National Laboratories, Albuquerque, New Mexico and Wyle Laboratories, Huntsville, Alabama are used in a multiple linear regression analysis to identify significant independent variables and refine the collector performance models. The refined collector performance models are used to characterize performance of three different parabolic trough collectors and two different compound-parabolic collectors, with good correlations between modeled and experimental performance.

25804 **Antireflection Pyrex envelopes for parabolic solar collectors.** McCollister, H.L.; Pettit, R.B. (Sandia National Laboratories, Albuquerque, NM). *Journal of Solar Energy Engineering;* **105**: No. 4, 425-429(Nov 1983). Contract AC04-76DP00789.

Parabolic trough solar collectors utilize glass envelopes around the receiver tube in order to reduce thermal losses. Antireflective (AR) coatings applied to the envelope can potentially increase the solar transmittance by 7 percent. An excellent AR surface can be formed on Pyrex (Corning Code 7740 glass) by first heat treating the glass to cause a compositional phase separation. After heat treating, a surface layer is removed using a pre-etch solution of aqueous ammonium bifluoride. Finally, the AR layer is formed by etching in a solution containing hydrofluorosilic and ammonium bifluoride acid. Processing parameters studied included the phase separation temperature and heat treatment time, the pre-etch time, and the etching bath temperature and time. AR-coated samples with solar transmittance values > 0.97, as compared to a value of 0.91 in untreated samples, were obtained for a range of heat treatment temperatures from 560-630°C. The phase separation time and temperature interact so that at 630°C short times are required (3 hrs) while at 560°C longer times are necessary (24 hrs). Optimum values for the other processing parameters are 12-18 min in the pre-etching bath, and 5-10 min in the film forming bath when maintained between 35-45°C. Application of this process to full scale 3-m-long X 6-cm dia Pyrex envelopes was successful in producing solar transmittance values ≥ 0.97.

25805 **Testing and analysis of a heat pipe solar collector.** Ribot, J.; McConnell, R.D. (Solar Energy Research Institute, Golden, CO). *Journal of Solar Energy Engineering;* **105**: No. 4, 440-445(Nov 1983).

We developed an integral heat pipe/evacuated-tube solar collector in which the inner receiver tubes form the evaporator sections of glass heat pipes. This paper describes both theoretical analyses and empirical tests, comparing the performance of the glass heat pipe solar collector with one of today's high efficiency evacuated tube solar collectors. The comparison demonstrates that the performance of the two collectors is effectively identical. The testing and analysis indicate that the glass wick-type glass heat pipe is an effective heat transfer system for evacuated-tube solar collectors.

25806 **Orientational relationships for optically non-symmetric solar collectors.** McIntyre, W.R.; Reed, K.A. (Solar Energy Group, Argonne National Laboratory, Argonne, IL). *Solar Energy;* **31**: No. 4, 405-410(1983). Contract W-31-109-ENG-38.

More details of collector orientations and incidence angle modifiers are required to specify the instantaneous optical efficiencies of optically non-symmetric solar collectors, such as those using

nonimaging concentrators, than to specify the efficiencies of symmetric collectors such as flat plates. In this paper, expressions are presented for the projected incidence angles necessary for evaluating the instantaneous optical efficiencies of non-symmetric collectors. These projected angles are also used when a nearly biaxial incidence angle modifier is approximated by the product of two single-axis incidence angle modifiers. In addition, relationships for incidence angles onto an absorber tube are developed. These differ from the angle onto a cover glazing, and they effect the absorptance of the tube's coating and the transmittance of a cover tube as used in tubular evacuated collectors.

25807 **Laboratory demonstration of self-creation capability of saturated solar ponds.** Jain, S.C.; Mehta, G.D. (Inter-Technology/Solar Corporation, Warrenton, Virginia 22186). *Alternative Energy Sources;* **1**: 249-263(Dec 1980). (CONF-801210—). Contract AC05-78ET20471.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Experiments performed on a potassium nitrate laboratory saturated pond have demonstrated that a saturated solar pond can self-generate a stable density gradient after complete mixing and can sustain a stable profile during repeated heating and cooling (no heating) cycles. During a salt precipitation test, it was observed that the pond can sustain supersaturation for quite some time, as it took more than 24 hours for salt to precipitate after the heat was switched off. Furthermore, it can maintain and correct a stable density stratification by itself. Results obtained on 4-hour, 6-hour and 8-hour heating and cooling cycles are presented. It was observed that the steady state temperature and density profiles were reached at the end of the first complete cycle. The salt precipitation started when the pond temperature dropped about 8°C below its saturation temperature.

1420 Heat Storage

REFER ALSO TO CITATION(S) 25789, 27026

25808 **(DOE/R7/01102—T1) Thermal energy storage system combining mass and PCM.** (Central States Energy Research Corp., Iowa City, IA (USA)). Nov 1982. Contract FG47-80R701102. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84007732.

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The intent of this project was to construct several concrete blocks with PCM (Phase Change Material) encapsulated and to test these blocks as to heat transfer rate with and without a highly conductive matrix cast within the PCM core. The tests were to be conducted on commercially available PCM's being sold for solar applications. Unfortunately, one of the three PCM's was no longer produced commercially for sale and another would not crystallize as claimed by the manufacturer. This left one PCM, paraffin wax (the most critical to this work), to be tested. The testing showed that substantial improvement (18.5%) of heat conduction to the center of the paraffin core was obtainable with only a 2% loss of latent heat storage capacity. This finding may have a significant impact on the container designs for hydrocarbon heat storage system by showing that reduced surface to volume ratios can produce adequate heat transfer rates to the center of the PCM mass, without significant loss of performance.

25809 **(SERI/TP—253-2157) Effect of soil conditions on solar pond performance.** Leboeuf, C.M.; Johnson, D.H. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1984. Contract AC02-83CH10093. 6p. (CONF-840402—3). NTIS, PC A02/M A01; GPO Dep. Order Number DE84000096.

From 6. annual ASME Solar Energy Division technical conference; Las Vegas, NV, USA (10 Apr 1984).

A recent effort to design a one-acre solar pond at the US Air Force Academy brought up several research issues pertaining to solar pond performance prediction. This report addresses those issues. Interactions of the pond with the soil below it have historically been estimated using very simplistic techniques that tend to ignore soil composition, moisture content, and the coupled heat and moisture transport phenomena. This study examines the models of soil thermal conductivity and heat and mass transport in soils under imposed temperature gradients to assess the potential applicability of these models to solar pond modeling. In addition, a computer simulation code is developed that incorporates the soil thermal conductivity model. Using the code, a parametric analysis was performed illustrating the impact of this property on pond behavior and the importance of experimental model verification for the range of soil temperatures experienced in solar ponds. Implications of the combined heat and moisture movement theory on solar pond performance are presented.

25810 **Analysis and test results for a molten salt thermal energy storage system.** Sterrett, R.H.; Scott, O.L. (Martin Marietta, Denver, CO). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **4**: 2037-2042(Aug 1982). (CONF-820814—).

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

A system has been developed to provide low cost thermal energy storage using molten salt. It consists of a hot tank to store the 565°C (1050°F) salt and a cold tank to store the 289°C (550°F) salt. The hot tank uses internal insulation protected by a liner to enable the use of a carbon steel shell for structural support. Due to the lower salt temperature, the cold tank can be a carbon steel shell with external insulation. This paper describes an analytical method used to predict the thermal performance of such systems and presents experimental data from a Subsystem Research Experiment (SRE) conducted by Martin Marietta Aerospace, Solar Energy Systems under contract from Sandia National Laboratories, Livermore, CA. The results from three of the SRE test cases are compared with the STS model results. These are 1) steady state operation, 2) concurrent charging and discharging, and 3) transient cooldown. The temperature difference between the analytical and experimental results were less than 10%. The internally insulated hot tank performed well.

25811 **Storing solar energy in thermally stratified tanks.** Cole, R.L.; Bellinger, F.O. (Argonne National Laboratory, Argonne, IL). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **4**: 2074-2081(Aug 1982). (CONF-820814—).

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

This paper describes how solar system tanks fail to stratify, a new solar system control strategy that allows stratification, a one-dimensional analytical model of thermally stratified tanks, experimental measurement of thermal stratification in tanks, and a correlation of experimental measurements with empirical constants in the analytical model. Failure to stratify is explained in terms of the critical Richardson number. The key to the new control strategy is to avoid a Richardson number that decreases during solar collection. The analytical model is an approximate solution containing two empirical constants. The empirical constants were adjusted to obtain the best leastsquares fit with experimental data and correlated with the Fourier and Richardson numbers. The new control strategy allows tanks to stratify and reduces the average collector operating temperature by as much as 20°C. The paper also describes several features of tank design that improve thermal stratification.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 25854

25812 **(DOE/ET/27161—2) Subsurface and seismic investigation of the geopressured-geothermal potential of south Louisiana. Final report.** Kinsland, G.L.; Paine, W.R.; Duhon, M.P.; Dungan, J.R.; Kurth, R.J.; Moore, D.R.; Lyons, W.S. (University of Southwestern Louisiana, Lafayette (USA). Dept. of Geology). Sep 1983. Contract AS05-78ET27161. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011273.

Specific sites (areas) for geopressured-geothermal energy potential have been evaluated: (1) Abbeville Area, (2) Chloe Area, (3) Turtle Bayou Field-Kent Bayou Field Area and (4) Lirette-Chauvin-Lake Boudreaux Area. To arrive at geologic conclusions concerning the geopressured-geothermal energy potential of each area, the following factors have been considered in this study: (1) depth of geopressured sands, (2) geopressured sand volumes, (3) porosities, (4) permeabilities, (5) temperatures, (6) salinities, (7) dissolved gas content, (8) structure - especially as it relates to continuity of reservoirs, and (9) petroleum prodution - espeially if the geopressured fluids are driving mechanisms for current petroleum prodution. To evaluate these parameters the most useful source of information has been petroleum well logs which most commonly are a continuous depth survey of the spontaneous potential (SP) and the electrical resistivity of the subsurface formations. A separate thesis for each of the above four areas was processed separately.

25813 **(USGS-OFR—83-438) Washington state basic data for thermal springs and wells as recorded in GEOTHERM.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 50p. USGS-OFS, Box 24524-Denver Federal Center, Denver, CO 80225.

This report on Washington is one of a series intended to preserve the data collected for GEOTHERM and make the data available to the public. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for Washington. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by county name and the name of the source. Also given are latitude, longitude (both in decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Also given are GEOTHERM record identifier, and temperature (°C).

25814 **Geo-heat center.** Lienau, P.J.; Fornes, A.O. (Oregon Inst. of Tech., Klamath Falls). *Geo-Heat Center Quarterly Bulletin;* 7: No. 4, 3-7(1983).

A summary is presented of the Geo-Heat Center from its origin in 1974. The GHC has been involved in a number of studies and projects. A few of these are: construction of a greenhouse based on geothermal applications, an aquaculture project raising freshwater Malaysian prawns, an investigation of ground water characteristics and corrosion problems associated with the use of geothermal waters, and the assessment of the potential utilization of direct-heat applications of geothermal energy for an agribusiness.

25815 **Background of the feasibility study of geothermal district heating in Tianjin.** Yao, S.K. (District Heating Program, Tianjin, China). *Geo-Heat Center Quarterly Bulletin;* 7: No. 4, 8-12(1983).

Tianjin is the largest user of low-temperature geothermal energy in China. It has been selected by the state as the model for the development and direct utilization of geothermal energy. There are 259 geothermal wells in the city, 75 of these are run by Tianjin Utility to supply water to residents and industrial users. The domestic, industrial, and agricultural uses of geothermal water are discussed. A drop in the level of the hot water has led to the building of a central district heating system and a plan for future exploitation of wells that are of higher temperature in areas outside the city.

25816 **Geothermal direct use in India.** Lund, J.W. (Oregon Inst. of Tech., Klamath Falls). *Geo-Heat Center Quarterly Bulletin;* 7: No. 4, 13-18(1983).

The results of a United Nations Development Program (UNDP) funded project for geothermal planning and recommendations in Northwestern India are presented. The work performed was to investigate the technical and economic feasibility of utilizing geothermal water at 90°-180° C for direct applications of geothermal energy.

25817 **Geothermal gradient map of the United States (exclusive of Alaska and Hawaii).** Kron, A.; Stix, J. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Transactions - Geothermal Resources Council;* 6: 35-37(Oct 1982).

This paper describes an update of the Geothermal Gradient Map of the Conterminous United States (Kron and Heiken 1980) and compares the changes made since the first map. The second map presents a compilation of over 1700 wells that have been measured for temperature below 50 m and whose temperature/depth profiles are linear, or composed of linear segments which reflect changes in the thermal conductivity of the rocks rather than hydrology. The data are displayed at an enlarged scale of 1:2,500,000 and in a new format which shows the location, depth, and gradient of each well in a single color-coded symbol. This edition contains over two times the amount of data shown on the first map and is accompanied by a table, listing for each well its location, depth, gradient, heat flow (where available), thermal conductivity (where available), and a reference. Over 200 references have been consulted and are presented with the data.

25818 **Oregon geothermal gradient data published.** Blackwell, D.D.; Black, G.L.; Priest, G.R. Portland, OR; Oregon Department of Geology and Mineral Industries (1981). vp. Oregon Department of Geology and Mineral Industries, 1005 State Office Building, Portland, OR 97201 $15.00.

This report contains data tables and temperature-depth plots of approximately 100 drill holes. A large number of new measurements in the Cascades and in Eastern Oregon are included.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 25834

25819 **(BMFT-FB-T—83-245) Geopressured aquifers. Exploitation of the energy potential of the thermal aquifer Endorf.** Pavlik, N.; Hantelmann, G. von; Mueller, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 33p. (In German). NTIS (US Sales Only), PC A03 MF/A01. Order Number DE84750928.

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The thermal aquifer Endorf (Rupel-Sandstone 4229 - 4264 m) is a geopressured aquifer. It was drilled in 1962 by the DEA (now Deutsche Texaco) while searching for hydrocarbons. In 1971 ownership of the well Endorf was passed via the Free State of Bavaria to the Jod Thermalbad Endorf AG. Based on previous investigations, a test programm was carried out in May/June 1982 in order to determine the energy potential and the production possibilities. For this purpose, pressure and temperature measurements and production tests were planned, executed and evaluated. The water in place is approx. $6x10^6 m^3$ and the gas in place is approx. $37x10^6 m^3$, i.e. approx. 6 m^3(Vsub(n)) of gas (96% methane) is produced per 1 m^3 water. At a production rate of 200 m^3 water per day and 1200 m^3(Vsub(n)) gas per day, a total energy of approx. $42x10^6$kWh can be recovered over a period of five years. The corresponding power will be nearly 1000 kW. Before this energy potential can be used, and following geological review, the provision of a second well for the purpose of circulation with the existing well should be investigated, followed by an economic evaluation based on the demand characteristics and the required supply network. Measurements and tests with improved measuring technology may become necessary.

25820 **(DOE/ET/27161—T1) Subsurface geology and geopressured/geothermal resource evaluation of the Lirette-Chauvin-Lake Boudreaux area, Terrebonne Parish, Louisiana.** Lyons, W.S. (University of Southwestern Louisiana, Lafayette (USA)). Dec 1982. Contract AS05-78ET27161. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011471.

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The geology of a 125 square mile area located about 85 miles southeast of Baton Rouge and about 12 miles southeast of Houma, Louisiana, has been studied to evaluate its potential for

geopressured/geothermal energy resources. Structure, stratigraphy, and sedimentation were studied in conjunction with pressure and temperature distributions over a broad area to locate and identify reservoirs that may be prospective. Recommendations concerning future site specific studies within the current area are proposed based on these findings.

25821 **(DOE/ET/27161—T2) Subsurface geology and potential for geopressured-geothermal energy in the Turtle Bayou field-Kent Bayou field area, Terrebonne Parish, Louisiana.** Moore, D.R. (University of Southwestern Louisiana, Lafayette (USA)). Sep 1982. Contract AS05-78ET27161. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011469.

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A 216 square mile area approximately 65 miles southwest of New Orleans, Louisiana, has been geologically evaluated to determine its potential for geopressured-geothermal energy production. The structural and stratigraphic analyses were made with emphasis upon the Early and Middle Miocene age sediments which lie close to and within the geopressured section. Three geopressured sands, the Robulus (43) sand, Cibicides opima sand, and Cristellaria (I) sand, are evaluated for their potential of producing geothermal energy. Two of these sands, the Robulus (43) sand and the Cibicides opima sand, meet several of the United States Department of Energy's suggested minimum requirements for a prospective geopressured-geothermal energy reservoir.

25822 **(DOE/ET/27161—T3) Subsurface evaluation of the geopressured-geothermal Chloe Prospect, Calcasieu Parish, Louisiana.** Kurth, R.J. (University of Southwestern Louisiana, Lafayette (USA)). Dec 1981. Contract AS05-78ET27161. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011467.

Portions are illegible in microfiche products; Thesis.

A 123 square mile area approximately 10 miles east of Lake Charles, Louisiana, has been studied to assess its potential geopressured-geothermal resources. Subsurface information was used to study the structure and stratigraphy of the area as they related to the development of geopressured aquifers. The Middle Frio Hackberry wedge was found to contain the geopressured-geothermal reservoir sand, as well as the shales responsible for the origin and sealing of the geopressured strata. The major reservoir within the wedge is the Hackberry massive A sand.

25823 **(DOE/ET/27161—T4) Subsurface and seismic investigation of the geopressured-geothermal potential of the Abbeville area of south Louisiana.** Duhon, M.P.; Dungan, J.R. (University of Southwestern Louisiana, Lafayette (USA)). Sep 1979. Contract AS05-78ET27161. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011468.

Portions are illegible in microfiche products; Thesis.

The structure investigated is a basin roughly bounded by the Abbeville Dome on the west, the Erath Dome on the southeast and the Grosse Isle Dome on the northeast and whose center is located at approximately Section 31 T14S R4E. The geopressured sands investigated are below approximately 12,800 feet (3901 M) in the center of the basin and consist of two groups of rather thin, discontinuous, marly sands. These two groups, rather arbitrarily defined, are termed the upper and lower geopressured sands and the following map types and analyses have been derived from subsurface data of each: structure, temperature, pressure, salinity and net sand maps; and porosity, permeability and methane content analyses.

25824 (DOE/ID/12044—T3, pp 3-28) **Overview of the geology of the central Oregon Cascade Range. Chapter 2.** Priest, G.R. (Oregon Dept. of Geology and Mineral Industries, Portland); Woller, N.M.; Black, G.L. 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

Eruption of voluminous silicic tuffs and lesser volumes of iron-rich basaltic to silicic lavas between about 40 and 18 m.y. B.P. and eruption of intermediate calc-alkaline lavas and subordinate tuffs between about 18 to 9 m.y. B.P. formed most of the volcanic pile in the central Western Cascade Range. The axis of volcanism had shifted to the vicinity of the High Cascade province by about 9 m.y. B.P., when eruption of more mafic, alkaline, and iron-rich lavas began. Slight local folding in the north-central Western Cascade Range also ended by about this time. Widespread north-south- to north-north-west-trending normal faulting accompanied uplift of the Western Cascade block relative to the High Cascade province between about 5 and 4 m.y. B.P. Voluminous basaltic lavas formed a broad platform in the High Cascade axis in the Quaternary as volcanism became slightly more silic. The youngest composite cones are chiefly andesitic in composition, with local dacitic to rhyodacitic eruptions, although basaltic eruptions have continued to occur on the surrounding platform into the Holocene.

25825 (DOE/ID/12044—T3, pp 29-38) **Preliminary geology of the Outerson Mountain-Devils Creek area, Marion County, Oregon. Chapter 3.** Priest, G.R.; Woller, N.M. (Oregon Dept. of Geology and Mineral Industries, Portland). 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

The Outerson Mountain-Devils Creek area was the site of mafic and subordinate andesitic to dacitic volcanism from about the middle Miocene (before 11.5 m.y. B.P.) to about 4.8 m.y. B.P. Rock sequences of both the late Western Cascade and the early High Cascade episodes occur in the area. Both sequences begin with basal mafic flows which give way to more silicic volcanic rocks upward. The late Western Cascade episode culminated with eruption of andesitic and dacitic ash flows (the tuffs of Outerson Mountain), and the early High Cascade episode culminated with emplacement of dacite and andesite plugs and dikes. Normal faulting on a N 30° W trend preceded volcanism of the early High Cascade episode (the Miocene-Pliocene lavas), and many of the basaltic flows in the sequence of early High Cascade age are olivine-normative, unlike the quartz-normative basalts of the late Western Cascade episode (lavas of Outerson Mountain). Uplift of the area some time after 4.8 m.y. B.P. was accompanied by a resurgence of highly mafic volcanism from the Mount Jefferson area to the east outside of the study area. Basaltic flows of the late High Cascade episode, some less silicic than flows of the previous early High Cascade episode, followed the canyon of the ancestral North Santiam River as it cut into the uplifted Western Cascade block. The late High Cascade volcanic episode, while beginning with basalt flows more mafic than basalts of the early High Cascade episode, culminated with andesitic and minor dacitic to rhyolitic eruptions in the High Cascade Range to the east. The late High Cascade episode, like the early High Cascade episode, was accompanied by extensional faulting.

25826 (DOE/ID/12044—T3, pp 39-48) **Geology of the Cougar Reservoir Area, Lane County, Oregon. Chapter 4.** Priest, G.R.; Woller, N.M. (Oregon Dept. of Geology and Mineral Industries, Portland). 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

Volcanic rocks of the early and late Western Cascade episodes crop out at Cougar Reservoir west of the major north-south Cougar fault. Volcanic rocks of the late Western and Cougar fault. A drill hole on the east block revealed that at least 152 m (499 ft) of down-to-the-east movement has occurred on the fault and that the dip on the fault plane is greater than 74° to the east. The fault cuts units of late Western Cascade age (lavas of Walker Creek) that have been K-Ar dated at 13.2 m.y. B.P. Pleistocene outwash gravels that overlie the fault zone are not offset. Stratigraphic arguments suggest that 366 m (1200 ft) to possibly more than 1033 m (3388 ft) of down-to-the-east movement on the fault may have ocurred. Stresses similar to those producing the fault may have caused the north-south elongation of a dacite intrusion dated at 16.2 m.y. B.P., but there is only permissive evidence for this. Lavas of the early High cascade episode which began to flow into the area between about 8.3 and 7.8 m.y. B.P. were probably prevented from flowing west by the scarp of the Cougar fault. Although most of the displacement probably occurred immediately prior to those eruptions, it is possible that displacements may have also occurred on the Cougar fault about 4 to 5 m.y. ago, when north-south faults formed east of the area. However, absence of an obvious topo-

graphic scarp today suggests that 5- to 4-m.y. B.P. displacements, if they ocurred, were small.

25827 (DOE/ID/12044—T3, pp 49-56) **Geology of the Lookout Point area, Lane County, Oregon. Chapter 5.** Woller, N.M.; Priest, G.R. (Oregon Dept. of Geology and Mineral Industries, Portland). 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

A sequence of tholeiitic lavas, here called the lavas of Black Canyon, was identified within the predominantly calcalkaline middle and upper Tertiary terrane of the Western Cascade province. These lavas are dated of other identified tholeiitic sequences in the Western Cascades. The lavas of Black Canyon flowed through a paleocanyon that was perpendicular to the Eugene-Denio lineament. It has been suggested by other researchers that this lineament is a zone of right-lateral strike-slip displacement. The authors could show no substantial lateral offset on the paleocanyon filled with tholeiitic lavas. Most mapped faults and shears in the Lookout Point area strike to the northwest, and the Eugene-Denio leneament in this area appears to be controlled by these northwest-trending structures. There is no evidence that these structures cut rocks younger than 18 m.y.

25828 (DOE/ID/12044—T3, pp 57-68) **Geology of the Waldo Lake-Swift Creek area, Lane and Klamath Counties, Oregon. Chapter 6.** Woller, N.M.; Black, G.L. (Oregon Dept. of Geology and Mineral Industries, Portland). 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

The Waldo Lake-Swift Creek area contains rocks representative of each of the four major age divisions which have been recognized in the central Oregon Cascades. Rocks of the early Western Cascade episode consist of tuffs and flows which range in composition from basaltic andesite through rhyolite. The oldest volcanic rocks of the late Western Cascade episode area olivine basalts to basaltic andesites which occur in the Koch Mountain and Tumblebug Creek area. The basalts are overlain by a thick sequence of two-pyroxene andesitic flows which grade into olivine clinopyroxene basaltic andesite which cap ridges in the western portion of the map area. Olivine basalts of the late High Cascade episode cover the High Cascade platform in the eastern portion of the map area and flow into the canyons of the deeply dissected Western Cascade province. Summaries of lithologic, chemical, and petrographic characteristics of each described map unit in the Waldo Lake-Swift Creek area are presented.

25829 **(DOE/ID/12057—T6) Geothermal potential along the Balcones/Ouachita trend, central Texas: ongoing assessment and selected case studies.** Woodruff, C.M. Jr.; Macpherson, G.L.; Gever, C.; Caran, S.C.; El Shazly, A.G. (Texas Univ., Austin (USA). Bureau of Economic Geology). Apr 1984. Contract AS07-79ID12057. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010826.

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A synopsis of the geologic conditions along the Balcones/Ouachita trend is presented. The problems in defining low-temperature resources and in recognizing anomalies are addressed. Local geologic and hydrologic conditions are assayed in terms of ambient thermal regimes, and hypotheses are presented for the origin of thermal waters.

25830 **(UCRL—88882) Inversion approach for thermal data from a convecting hydrothermal system.** Kasameyer, P.; Younker, L.; Hanson, J. (Lawrence Livermore National Lab., CA (USA); Terra Tek Research, Salt Lake City, UT (USA)). 1983. Contract W-7405-ENG-48. 32p. (CONF-8308157—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009871.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

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Efforts to invert thermal data from 13 deep geothermal wells, and from additional shallow heat-flow holes, in order to determine the age and total flow rate of the Salton Sea hydrothermal system are described. The data were inverted for a very restrictive model: single-phase, horizontal flow along prescribed flowlines in a single aquifer bounded by an impermeable cap and base. With simplifying assumptions, the results are shown to depend on only two parameters, the system age, and the aquifer/cap thickness ratio. The surface gradient and temperature distribution within the cap are calculated analytically for all possible parameter values. Those parameters producing temperatures that agree with observations are identified, and the range of acceptable parameters is reduced by conclusions drawn from other geophysical data. The cap thickness is inferred to be 500m from thermal and lithologic data from the wells. The aquifer thickness is limited to less than 2500m by seismic, resistivity and magnetic data. It is concluded that if this model is valid, the system age is constrained between 3000 and 20,000 years.

25831 **Evidence of former higher temperatures from alteration minerals, Bostic 1-A Well, Mountain Home, Idaho.** Arney, B. (Los Alamos National Laboratory Earth and Space Sciences Division, Los Alamos, New Mexico). *Transactions - Geothermal Resources Council;* 6: 3-6(Oct 1982).

Cuttings from the silicic volcanics in the Bostic 1-A well near Mountain Home, Idaho have been examined petrographically with the assistance of x-ray diffraction and electron microprobe analyses. Our results indicate that these rocks have been subjected to much higher temperatures than were observed in the well in 1974, when a static temperature log was run. It is not known to what extent the alteration may be due to greater depth of burial in the past, or whether it resulted from an early hydrothermal system of higher temperature than the one now observed.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 25819, 25823, 25828, 25850, 26990

25832 **(BMFT-FB-T—83-237) Development of an active audiomagnetotelluric equipment.** Musmann, G.; Otten, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 39p. (In German). NTIS (US Sales Only), PC A03 MF/A01. Order Number DE84750931.

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It was the aim of this project to develop an active audiomagnetotelluric equipment for geothermal exploration of the upper 10 km. For this purpose a power-NF-generator (8 kW) for the frequency range DC-2 kHz was developed. This power is fed into the ground using an electric dipole of 300 m length. the Receiving station (3 orthogonal induction coils and 2 electric field sensors) must have a distance of at least 5 times the dipole length and 3- to 5 times the skindepth for being located in the so-called far-field of an ideal dipole. Taking into account the natural and technical noise and the sensitivity of the equipment the maximum distance of the receiver can be up to 20 km. With these limitations a signal to noise ratio of 20 dB can be achieved if the correlation techniques with integration times of 100 periods is applied. For this purpose a PCM telemetry link between transmitter and receiver is established for transmitting the phase and frequency of the applied signal to the correlator. Thus it will be possible to get an information of the conductivity distribution of the upper 10 km. The computation of the psub(s)-curves is done already in the fields. The total station was tested in Travale (Tuscany) geothermal field in October 81.

25833 (DOE/ID/12044—T3, pp 69-76) **Heat flow in the Oregon Cascades. Chapter 7.** Black, G.L. (Oregon Dept. of Geology and Mineral Industries, Portland); Blackwell, D.D.; Steele, J.L. 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

Heat-flow data from 170 holes, most of them located in the Willamette Valley, Western Cascade, and High Cascade physiographic provinces, are tabulated. The data indicate that a zone of low heat flow averaging 43 +- 1 mW/m^2 occupies the Willamette Valley province and most of the Western Cascade province. A zone of higher heat flow averaging 104 +- 9 mW/m^2 occupies the

High Cascade province and extends about 10 km (6 mi) into the Western Cascade province. The transition between the two zones is very narrow, averaging less than 10 km (6 mi) in width throughout most of its length in Oregon. Heat flow in the Willamette Valley and Western Cascade provinces is primarily conductive. In the High Cascade province, high lateral permeability makes the measurement of meaningful heat-flow values virtually impossible at depths of less than 300 m (984 ft). A 25-mgal negative gravity anomaly which is superimposed on a regional negative trend occurs at the heat-flow transition zone. Thermal modeling of the heat-flow data and gravity modeling indicate that temperatures as high as 700° C may underlie the High Cascade province and that it is possible that molten rock underlies large portions of the high heat-flow zone. Three conceptual models that may explain the origin of the north-south line of hot springs paralleling the High Cascade-Western Cascade boundary are described. Finally, numerical estimates for the geothermal potential of the Cascade Range of Oregon are made. The estimates are based on the heat-flow data and themal modeling.

25834 (DOE/ID/12044—T3, pp 77-87) **Geothermal exploration in the central Oregon Cascade Range. Chapter 8.** Priest, G.R. (Oregon Dept. of Geology and Mineral Industries, Portland). 1983. NTIS, PC A08/MF A01.

In Geology and geothermal resources of the central Oregon Cascade Range. Special Paper 15.

Exploration in the central Oregon Cascades should be focused within the High Cascade heat-flow anomaly. In the volcanic rocks of the western Cascade episode, gothermal aquifers are most likely to occur where thick sections of brittle intrusive or holocrystalline flow rock have been recently fractured by tectonic deformation. In the younger rocks of the High Cascade episode, exploration should be focused on unusually thick sequences within large grabens or calderas; the Waldo Lake-Lookout Mountain area and High Cascade province 20 km (12 mi) north of Breitenbush Hot Springs are probable examples. Areas of youthful silicic volcanism, such as Mount Jefferson, Crater Lake, and South Sister, are particularly attractive heat sources. A high priority target is the silicic highland around the Three Sisters. Because most of this area is in the Three Sisters Wilderness, however, the only portion that may be exploited is in the Devils Lake-Sparks Lake area.

25835 **(DOE/ID/12079—89) Deep resistivity structure in southwestern Utah and its geothermal significance.** Wannamaker, P.E.; Ward, S.H.; Hohmann, G.W.; Sill, W.R. (Utah Univ., Salt Lake City (USA)). Feb 1983. Contract AC07-79ID12079. 104p. (ESL—109). NTIS, PC A06/MF A01; GPO Dep. Order Number DE84012193.

Magnetotelluric (MT) measurements in southwestern Utah have yielded a model of resistivity structure in this area to a depth of about 100 km. The MT observations are strongly affected by Great Basin graben sedimentary fill, which constitutes conductive upper-crustal lateral inhomogeneity and requires simulation using two- and three-dimensional modeling algorithms before deeper portions of the resistivity section can be resolved. Included in the model is a layer of low resistivity (20 Ω-m) residing from 35 to 65 km depth. Sensitivity tests of the data to the structure weigh strongly against the top of this layer being as shallow as 25 km and against the conductivity and thickness of the layer being highly correlated. No intra-crustal low-resistivity layer is indicated by the MT data.

25836 **(DOE/ID/12079—106) Bias removal for conventional magnetotelluric data.** Stodt, J.A. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Sep 1983. Contract AC07-79ID12079. 63p. (ESL—123). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012189.

An algorithm has been developed for the removal of autopower bias errors from conventional magnetotelluric (MT) data. Nonlinear equations involving autopowers as unknowns with crospower coefficients are obtained by cross substitutions between the eight referenced impedance equations to eliminate the four impedances. Although exact solutions to the nonlinear equations can be computed, they are often sensitive to noise components in the crospower coefficients, due to degeneracy of the equations as Z/sub xx/ and Z/sub yy/ approach zero or as the coherence between the magnetic field components H/sub x/ and H/sub y/ approaches unity. However, the ordinary coherence functions between various pairs of the horizontal field components provide additional information. This information is incorporated as constraints by developing a constrained iterative solution for the autopowers. The solution is outlined and its usefulness is explored with examples of its application to field data.

25837 **(DOE/ID/12079—109) Results of a detailed gravity survey in the Alamosa Area, Alamosa County, Colorado.** Mackelprang, C.E. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Sep 1983. Contract AC07-79ID12079. 37p. (ESL—126). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012188.

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A total of 322 stations, centered on the City of Alamosa, were surveyed with a gravimeter during September 1981. These data have shown the Alamosa horst to have an irregular top. This irregularity is thought to be caused by paleovalleys and/or downdropped fault blocks within the Precambrian horst. The City of Alamosa lies directly over a local gravity low. Volcanic rocks within this low may contain a reservoir for geothermal fluids, as yet unsubstantiated by drilling. Thermal fluids are thought to enter the Alamosa area via aquifers from the west (San Juan Mountains) and/or from the Rio Grande Rift zone with the fluids rising along fractures within and bordering the horst. The most favorable drilling targets appear to be either near the center of the local gravity low or in the fracture zone at the edges of the inferred downdropped fault blocks.

25838 **(SAND—84-0254) Development of a borehole directional antenna at VHF.** Chang, H.T.; Scott, L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010746.

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The feasibility of constructing a directional VHF (30 MH/sub z/ to 300 MH/sub z/) antenna to physically fit into a small borehole is investigated. The study was carried out in a test chamber containing a 15 cm diameter borehole surrounded by sand which can be moistened with water or brine to adjust the dielectric constant and electrical conductivity. Electric field measurements were made for an eccentrically positioned monopole, a corner reflector and a two-element array for a number of possible configurations. Using an eccentric monopole, the best beamwidth obtained was 78° and the front-to-back ratio was 3.5 db. The front-to-back ratio was increased to 8.5 db when two element arrays were arranged in such a way as to provide the optimum radiation pattern. However, the best results were achieved using a corner reflector: 60° beamwidth and 13 db front-to-back ratio. It is concluded that a directional VHF antenna can be designed for downhole application.

25839 **(USGS-OFR—83-427) Basic data for thermal springs and wells as recorded in GEOTHERM: Arizona.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). May 1983. 205p. USGS Open File Service, Box 24524, Denver Federal Center, Denver, CO 80225.

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GEOTHERM sample file contains 314 records for Arizona. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for Arizona. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by the county name and the name of the source. Also given are latitude, longitude (both use decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix B is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Adjacent one-degree blocks which are published as a 1:250,000 map are combined under the appropriate map name. Also given are GEOTHERM record

identifier, and temperature (°C). A bibliography is given in Appendix D.

25840 **(USGS-OFR—83-432) Montana: basic data for thermal springs and wells as recorded in GEOTHERM.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 166p. USGS-OFS, Box 25425-Denver Federal Center, Denver, CO 80225.

GEOTHERM sample file contains 225 records for Montana. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for Montana. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by the county name and the name of the source. Also given are latitude, longitude (both use decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix B is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Adjacent one-degree blocks which are published as a 1:250,000 map are combined under the appropriate map name. Also given are GEOTHERM record identifier, and temperature (°C). A bibliography is given in Appendix D.

25841 **(USGS-OFR—83-434) Basic data for thermal springs and wells as recorded in GEOTHERM: New Mexico.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 175p. USGS Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225.

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GEOTHERM sample file contains 251 records for New Mexico. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for New Mexico. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by the county name and the name of the source. Also given are latitude, longitude (both use decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix B is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Adjacent one-degree blocks which are published as a 1:250,000 map are combined under the appropriate map name. Also given are GEOTHERM record identifier, and temperature (°C). A bibliography is given in Appendix D.

25842 **(USGS-OFR—83-439) Basic data for thermal springs and wells as recorded in GEOTHERM: Wyoming.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). May 1983. 216p. USGS Open File Service, Box 24524, Denver Federal Center, Denver, CO 80225.

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GEOTHERM sample file contains 356 records for Wyoming. Three computer-generated indexes are found in appendices A, B, and C of this report. The indexes give one line summaries of each GEOTHERM record describing the chemistry of geothermal springs and wells in the sample file for Wyoming. Each index is sorted by different variables to assist the user in locating geothermal records describing specific sites. Appendix A is sorted by the county name and the name of the source. Also given are latitude, longitude (both use decimal minutes), township, range, section, GEOTHERM record identifier, and temperature (°C). Appendix B is sorted by county, township, range, and section. Also given are name of source, GEOTHERM record identifier, and temperature (°C). Appendix C is first sorted into one-degree blocks by latitude, and longitude, and then by name of source. Adjacent one-degree blocks which are published as a 1:250,000 map are combined under the appropriate map name. Also given are GEOTHERM record identifier, and temperature (°C). A bibliography is given in Appendix D.

25843 **(USGS-OFR—83-455) Temperature profiles from Salt Valley, Utah, thermal conductivity of 10 samples from drill hole DOE 3, and preliminary estimates of heat flow.** Sass, J.H.; Lachenbruch, A.H.; Smith, E.P. (Geological Survey, Menlo Park, CA (USA)). 1983. 21p. NTIS, PC A02/MF A01. Order Number DE84900996.

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As part of a thermal study of the Salt Valley anticline, Paradox Basin, Utah, temperature profiles were obtained in nine wells drilled by the Department of Energy. Thermal conductivities were also measured on ten samples judged to be representative of the rocks encountered in the deepest hole (DOE 3) (R. J. Hite, personal communication, November 21, 1980). In this interim report, the temperature profiles and thermal conductivities are presented, together with some preliminary interpretive remarks and some suggestions for additional work.

25844 **Geology, resistivity, and hydrogeochemistry of the Ojo Caliente Hot Springs area, northern New Mexico.** Six, J.; East, J.; Goff, F.; Hoffers, B.; Pearson, C.; Vuataz, F. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Transactions - Geothermal Resources Council;* **6**: 55-58(Oct 1982).

Geothermal fluids of the Ojo Caliente area discharge from a northeast trending normal fault that juxtaposes Precambrian metarhyolite and Tertiary sediments. An electrical resistivity survey shows that the fluids emerge from the fault and flow as a plume of thermal water into cold aquifers east of the fault. Geochemistry of fluids indicates a maximum reservoir temperature at depth of 80°C with no suggestion of high temperature isotopic exchange between water and reservoir rocks. From this data, we believe the Ojo Caliente system is suitable only for small-scale direct use geothermal applications.

25845 **Geothermal resource maps and bottom hole temperature surveys.** Gosnold, W.D. (Department of Geography and Geology, University of Nebraska at Omaha). *Transactions - Geothermal Resources Council;* **6**: 23-26(Oct 1982).

Knowledge of subsurface temperatures obtained from heat flow and equilibrium temperature measurements were used as a basis for evaluation of the usefulness of the non-equilibrium temperatures of oil and gas wells for geothermal exploration. We find that the data in the Geothermal Gradient Map of North America do not conform to the thermal regime of Nebraska; and, that if the BHT data were the only data used, we would have underestimated our resource by about 80%. Differences in geological sections and heat flow between Nebraska and the U.S. Gulf coast where the correction data for the USGS map were obtained are the reasons for the discrepency. Some significant inaccuracies in the BHT data may not be correctable.

25846 **Stratigraphic permeability in the Baca geothermal system, Redondo Creek Area, Valles Caldera, New Mexico.** Hulen, J.B.; Nielson, D.L. (Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah). *Transactions - Geothermal Resources Council;* **6**: 27-30(Oct 1982).

Synthesis of surface and borehole data from the Baca geothermal system, as defined by drilling to date in the Redondo Creek area of the Valles Caldera, New Mexico, indicates that thermal fluid flow in the system is partially controlled by distinct stratigraphic aquifers. These aquifers are relatively thin, laterally restricted beds of non-welded tuff and tuffaceous sandstone, confined primarily to the Quaternary Bandelier Tuff. Recognition of the role of these rocks in reservoir definition at Baca should improve chances for future geothermal discoveries in the Valles Caldera and similar settings elsewhere.

25847 **Mineral zonation and stable isotope geochemistry of a production well in the Geysers Geothermal field, California.** Sternfeld, J.N.; Elders, W.A. (Institute of Geophysics and Planetary Physics University of California, Riverside, CA). *Transactions - Geothermal Resources Council;* **6**: 51-54(Oct 1982). Contract AT03-80SF11458.

Petrologic and stable isotope geochemical studies were conducted on well cuttings from a Sulphur Banks tract steam well in the Geysers. The observed hydrothermal mineral zonation is indicative of an extremely hot (>300°C) water-dominated geothermal system characterized by high fluid flow associated with fault contacts. Strata within the steam reservoir are not distinguished by diagnostic steam-derived secondary alteration products. However, a late stage generation of calcite was interpreted to have been deposited during the transition of the reservoir fluid to the vapor phase. The distribution of this material is restricted to a shallow zone (<600m) corresponding to the shallow steam anomaly reported in the Sulphur Banks area.

1505 Economic And Financial Aspects

25848 **(DOE/SF/11727—T1) Federal geothermal royalty income derived from the benefits of government-sponsored R and D.** Amundsen, C.B.; Cassel, T.A.V.; Kathan, D.W. (Technecon Analytic Research, Inc., Philadelphia, PA (USA)). 31 Jan 1984. Contract AC03-83SF11727. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010759.

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The ability of Federally-sponsored geothermal R and D to, in effect, pay for itself through increased royalty payments resulting from enhanced resource development on Federal lands is investigated. The report concludes that achievement of current Federal R and D objectives is likely to result in significant royalty returns to both state and Federal governments. These returns are measured in terms of the increase in royalty payments attributable to the achievement of Federal R and D objectives, as opposed to those payments which would be expected from the on-going low level of private sector R and D absent any Federal support. To perform this analysis, an integrated approach sequentially addresses (1) future wildcat drilling activity, (2) the number and quality of new resource discoveries, (3) the technological potential (megawatts) of the discovered resource base, and the likelihood that it will be developed, and (4) the royalty income which will be generated as a result of development of Federal land. This computer-based modeling approach has been developed by Technecon over the last 5 years under the sponsorship of both the Department of Energy and private industry. Portions of this model have been specially modified and updated during the course of this study.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 25745, 25852

25849 **(DOE/ID/01523—4) Direct contact condensation of immiscible fluids in packed beds.** Thomas, K.D.; Jacobs, H.R.; Boehm, R.F. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering). Nov 1978. Contract AS07-76ID01523. 87p. (IDO—1523-4; UTEC—78-040). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010394.

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An experimental study of a film type direct contact heat exchanger using immiscible fluids is made. Laboratory experiments were conducted on a R-113-water system using both 2.5 cm Berl saddles and 3.2 cm spheres as packing, in a 14.6 cm diameter column. The configuration was counter flow, with the vapor phase entering at the base of the column, and condensing on the laminar water film that coated the packing surface. Packing height, water temperature and both water and vapor flow rates were varied in obtaining heat transfer data. These and other packed bed heat transfer data published in the literature were reduced and correlated to yield a relationship between the Stanton number and the important vessel operating parameters.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 26285

25850 **(DOE/ID/12079—103) Interpretation of self-potential measurements during injection tests at Raft River, Idaho. Final report.** Sill, W.R. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Sep 1983. Contract AC07-79ID12079. 25p. (ESL—120). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012187.

Self-potential measurements before and during injection tests at Raft River KGRA, Idaho indicate a small negative change. The magnitude of the change (5 to 10 mV) is near the noise level (5 mV) but they extend over a fairly broad area. The presence of a cathodic protection system clouds the issue of the validity of the changes, however the form of the observed changes cannot be explained by any simple change in the current strength of the protection system. Furthermore, similar changes are observed for two separate tests, months apart. Modeling of the changes indicate that they are likely caused by a fracture extending from the reservoir (1400 m) to close to the surface.

25851 **(DOE/NV/10150—4) Brine and gas recovery from geopressured systems. I. Parametric calculations.** Garg, S.K.; Riney, T.D. (S-Cubed, La Jolla, CA (USA)). Feb 1984. Contract AC08-80NV10150. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011831.

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A series of parametric calculations was run with the S-CUBED geopressured-geothermal simulator MUSHRM to assess the effects of important formation, fluid and well parameters on brine and gas recovery from geopressured reservoir systems. The specific parameters considered are formation permeability, pore-fluid salinity, temperature and gas content, well radius and location with respect to reservoir boundaries, desired flow rate, and possible shale recharge. It was found that the total brine and gas recovered (as a fraction of the resource in situ) were most sensitive to formation permeability, pore-fluid gas content, and shale recharge.

25852 **A calcium carbonate scale inhibitor for direct-contact binary geothermal service.** Auerbach, M.H.; Olander, R.G.; Rapier, P.M.; Reimer, R.A. (Pfizer Central Research). *Journal of Petroleum Technology;* **35**: No. 9, 1546-1552(Aug 1983).

A 500-kW direct-contact binary-cycle pilot geothermal power plant was constructed and successfully operated free of scale at the U.S. DOE East Mesa geothermal test facility. The pilot plant used an Elgin tower directcontact heat exchanger (DCHX) with isobutane as the working fluid. Initial tests with the untreated 340°F (170°C) geothermal brine gave heavy calcium carbonate fouling of the brine boost pump, flow monitors, and flow-control valves within 20 to 50 hours of startup. Use of 2 ppm high-temperature polymeric scale inhibitor in the feed brine enabled plant operation for more than 700 hours without formation of detrimental scale. The antiscalant was not extracted into the working fluid and did not emulsify the hydrocarbon/brine interface. On the basis of dosage and flow, the additive cost was calculated to be about 0.06 per net kW-hr of power generated. Calcium carbonate scaling in a direct-contact binary-cycle geothermal power plant using up to 340°F (170°C) brine can be easily controlled with low dosages of a maleic terpolymer threshold antiscalant. This additive permits extended operation and reduces shutdown frequency for equipment maintenance. No significant additive/working-fluid interactions have been noted, although cleanout of prior scale gave a foamy suspension at the brine surface in the DCHX tower. The cost of using threshold antiscalant polymers in geothermal power plants suffering critical carbonate scaling is roughly an order of magnitude lower than the cost of periodic shutdown and cleaning. In this case, the additive cost was 0.06 /kW-hr of net power output, or 1.5% of power value. Use of such a thermally stable additive by downhole injection may enable greater utilization of liquid-dominated geothermal resources by permitting scale-free flow of two-phase fluid under artesian conditions.

25853 **Geothermal cement: high temperature downhole tests: continuation of an API project.** Pettitt, R.A.; Rowley, J.C. (Los Alamos National Lab., NM). *Bulletin, Geothermal Resources Council (Davis, California);* **12**: No. 8, 3-6(Aug 1983).

A research program, funded by DOE, on developing geothermal cement mixtures that will give optimum qualities under harsh downhole conditions is discussed. Downhole static tests and downhole pumpdown tests are described. This program will lead to the determination of suitable high-temperature cement mixtures, with improved strength, durability and pumpability characteristics for the completion and repair of wells in a corrosive fluid environment at very high temperatures.

25854 **Magma energy: the ultimate heat source for geothermal fields.** Hardee, H.C. (Sandia National Lab., Albuquerque, NM). *Bulletin, Geothermal Resources Council (Davis, California);* **11**: No. 7, 3-7(Jul 1982).

A scientific feasibility study, funded by DOE/Basic Energy Sciences, of extracting energy directly from buried magma sources is discussed. This study has examined the problems of locating and drilling into the magma and then extracting useful quantities of energy from the magma. Theoretical calculations with supporting laboratory and field measurements have been used to show that there are no theoretical or physical barriers that prevent the direct extraction of energy from magma. As a result of this study it has been concluded that magma energy utilization is scientifically feasible.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 25787, 25819

25855 **(CONF-780133—) Direct utilization of geothermal energy: a symposium.** (Geothermal Resources Council, Davis, CA (USA)). 1978. Contract AS03-76ET28484. 151p. NTIS, PC A08/MF A01. Order Number DE.

From Direct use of geothermal energy; San Diego, CA, USA (31 Jan 1978).

Abstracts were prepared for 25 papers. (MHR)

16 Tidal And Wave Power

REFER ALSO TO CITATION(S) 25652

17 WIND ENERGY

REFER ALSO TO CITATION(S) 25652, 26163

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 25858

25856 (Juel-Spez—195, pp 5-14) **Wind data.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

Wind speed and direction data had been provided by four countries. These wind data evaluation investigations are carried out for Japan, the Netherlands, Sweden and USA. Analysis show that it is not self-evident that the wind speed and direction data are representative for the period (hour, half hour, two minutes) they are assigned to. The prospects of optaining rather accurate wind speed forecasts for periods up to 6 hours do not look good. Techniques have to improved to forecast the wind speed casily and accurately.

1703 Regulations

REFER ALSO TO CITATION(S) 25857

1704 Economics

REFER ALSO TO CITATION(S) 25860, 26166

25857 **(DOE/CE—0062) Wind a practical source of energy for you.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). 1984. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010938.

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The facts which must be considered in determining the feasibility of wind energy for a particular application are briefly introduced. Seven steps are listed for making the determination: evaluating potential legal and environmental problems, evaluating energy requirements, evaluating the wind resource, selection of the system and its components, evaluation of the cost of the system with federal and state incentives, and other considerations. (LEW)

25858 **(Juel-Spez—195) Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.** Dub, W.; Pape, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Energieforschung). Mar 1983. 159p. NTIS (US Sales Only), PC A08 MF/A01. Order Number DE84750944.

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The report summarizes four case studies concerning the value of large-scale wind turbines to electric utilities. The report describes a methodology for the analysis of the value of large-scale wind turbines to electric utilities. The methodology is applied to meteorological, wind turbine, utility and socioeconomic data. The value analysis was carried out for the year of reference 1985 and included different levels of wind turbine penetration. The value analysis is composed of a series of models which require input data associated with utility system operation, utility financial setup, general economy, wind resource and wind tubines. Separate abstracts were prepared for the 6 chapters of this report.

25859 (Juel-Spez—195, pp 74-114) **Value determination of wind turbines.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

Cost estimates of wind turbines are based on vague assumptions regarding production costs and learning curves. The report gives - accounting all uncertainties of cost estimates - an approach which determines the breakeven cost of wind turbines. The approach looks at the maximum savings caused by wind turbines in the utility system over some predefined planning horizon. The breakeven value per wind turbine is estimated in terms of the savings realized both in the electric utility all day-production and the expansion planning for conventional units. It is mainly determined by the production savings not by the capital savings.

1705 Environmental Aspects

REFER ALSO TO CITATION(S) 25857, 25858

25860 (Juel-Spez—195, pp 115-136) **Economic and environmental impacts and institutional factors.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

The report presents observations and conclusions regarding the current and future potential of wind power for utilities. These are land use of wind power plants, off-shore siting, visual pollution, television interference and wind turbine noise, interfacing and transmission, institutional factors, market demand, socioeconomic options etc.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 25858

25861 (Juel-Spez—195, pp 15-21) **Wind turbine generation statistics.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

The wind turbine output has in principal been calculated via the steady-state performance curve. Four wind turbines were modeled for a study. The relevant parameters utilized in the generation calculations are the rated power (MW), the cut-in (m/s), the rated wind speed (m/s), the cut-out (m/s) and the hub height (m).

25862 (Juel-Spez—195, pp 22-53) **Integration of wind turbines into the utility power generation and control system.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

Wind electric generation into utility systems can be classified into three major categories: planning, operations and dynamic interaction. The report gives a detailed discussion of the utility planning procedures in current use, and of the unique problems of the integration of wind power into the utility generation system is given. The report is intended to serve as a guide to understanding utility systems concerns, not solving them. Solutions can only be given site and utility specific.

25863 (Juel-Spez—195, pp 54-73) **Displacement of conventional capacity by wind turbines.** Dub, W.; Pape, H. Mar 1983. NTIS (US Sales Only), PC A08 MF/A01.

In Implementing agreement for a programme of research and development on wind energy conversion systems. Annex 3a.

The displacement of conventional units (including nuclear units) by wind turbines must be subject to the condition that the system reliability is maintained. This means that a generation mix composed of wind turbines and conventional units must guarantee a power supply with the same degree of reliability as would do a power plant mix merely composed of conventional units. The report contents a long-term system reliability concept with the available capacity of thermal units, hydro plants and wind turbines. It shows, that the power plant mix guarantees a safe power supply when integrating wind turbines.

25864 **(N—8410661) How to protect a wind turbine from lightning. Final Report.** Dodd, C.W.; Mccalla, T. Jr.; Wood, J.G. (Southern Illinois Univ., Carbondale (USA)). Sep 1983. 111p. (NASA-CR—168229; DOE/NASA—0007-1). NTIS, PC A06/MF A01.

Techniques for reducing the chances of lightning damage to wind turbines are discussed. The methods of providing a ground for a lightning strike are discussed. Then details are given on ways to protect electronic systems, generating and power equipment, blades, and mechanical components from direct and nearby lightning strikes.

25865 **Difficulties in using power laws for wind energy assessment.** Sisterson, D.L.; Coulter, R.L.; Hicks, B.B.; Wesley, M.L. (Atmospheric Physics Section, Radiological and Environmental Research Division Argonne National Laboratory, Argonne, IL). *Solar Energy;* **31**: No. 2, 201-204(1983).

A 1/7 power law is often used to estimate atmospheric wind profiles. The use of this relationship, while perhaps appropriate in a climatological sense for daytime wind profiles in the lower atmosphere, frequently results in serious underestimates of wind speeds aloft at night. Several years of wind speed data from a 45 m tower and from use of a Doppler acoustic sounder (sodar) indicate that low-level wind speed maxima seem to form on 50 per cent of summer nights and 15 per cent of winter nights in northeastern Illinois. Even with 24 hr averages, the extrapolation of 6 m wind speeds to those at 45 m calculated with the 1/7 power law expression are found to be approximately 15 per cent too small, corresponding to a 40 per cent underestimate of wind power potential.

25866 **Performance of wind turbines in a turbulent atmosphere.** Sundar, R.M.; Sullivan, J.P. (School of Aeronautics & Astronautics, Purdue University, West Lafayette, IN). *Solar Energy;* **31**: No. 6, 567-575(1983).

The effect of atomospheric turbulence on the power fluctuations of large wind turbines is studied. The significance of spatial non-uniformities of the wind is emphasized. The turbulent wind correlation in time and space is simulated on the computer by Shinozukas method. The wind turbulence is modeled according to the Davenport spectrum with an exponential spatial correlation function. The rotor aerodynamics is modeled by simple blade element theory. Comparison of the spectrum of power output signal between 1-D and 3-D turbulence, shows the significant power fluctuations centered around the blade passage frequency.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 26157, 26912

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 25666, 25666, 25862, 25863, 26069, 26071, 26074, 26076, 26080, 26242

25867 **(DOE/ET/29108—T1-Pt.1) Analysis and characterization of security regions in power systems. Part I. Load flow feasibility conditions in power networks.** Jarjis, J.; Galiana, F.D. (McGill Univ., Montreal, Quebec (Canada)). Mar 1980. Contract AC01-77ET29108. 382p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE84010348.

Portions are illegible in microfiche products; Thesis. Submitted to McGill University, Montreal, Quebec, Canada.

A set theoretic analysis of loadflow feasibility of a general power network with arbitrary PQ, PV and slack buses is presented. Load-flow feasibility is that property of a power network defining the theoretical limitations on the bus injections under which a steady state equilibrium exists. The set theoretic analysis is based on the study of the conical loadflow feasibility region. This region is characterised by a set of supporting hyperplanes each of which defines an explicit necessary condition for loadflow feasibility on the bus injections. A quantitative measure of loadflow feasibility for an arbitrary given operating injection vector is defined through a computable scalar stability margin. This stability margin permits the loadflow feasibility of different injections and network structures to be quantitatively compared and analysed.

25868 **(DOE/ET/29108—T1-Pt.2) Analysis and characterization of security regions in power systems. Part II. Security regions in power networks.** Banakar, M.H.; Galiana, F.D. (McGill Univ., Montreal, Quebec (Canada)). Mar 1980. Contract AC01-77ET29108. 342p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84010347.

Portions are illegible in microfiche products; Thesis. Submitted to McGill University, Montreal, Quebec, Canada.

The analysis and characterization of the steady-state security of a bulk-power electric system is investigated in a region-wise or set-theoretic framework. The study is divided into three parts: a detailed examination of the theoretical aspects of general security regions; a formulation and analysis of the problem of characterizing a set of secure operating points by a simple, explicit function; and an investigation into the secure loadability of a power system. Based on the results of the theoretical study, general approximate relations expressing dependent load flow variables in terms of the nodal injections are derived. Their degree of accuracy and extent of validity are investigated through analytical and simulation-based analyses. The general problem of characterizing subsets of a security region by simple, explicit functions is formulated as an optimization problem. For the case where the subsets are expressed by ellipsoids, two algorithms are developed and tested. The problem is then extended to include embedding the largest ellipsoid of a fixed orientation inside a security region. The application of explicit security sets to the problem of predictive security assessment is studied in detail. A number of explicit security subsets overlapping along the predicted daily trajectory is used to define a "security corridor". This pre-

dicted corridor has the property that as long as the actual trajectory stays within it, very little computation is needed to assess the system security.

25869 **(DOE/ET/29365—8) Supplemental control strategies for the transient stability enhancement of multimachine power systems.** (Purdue Univ., Lafayette, IN (USA)). Aug 1983. Contract AC01-79ET29365. 235p. NTIS, PC A11; 3; GPO Dep. Order Number DE84010330.

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The contribution of this research is in the area of multimachine control, and, in particular, a power system emergency state control. Topics concerning control models, optimization criteria and characteristics of supplementary controls have been addressed. Dynamic programming is used to derive a switching strategy which takes the form of a feedback control. Since an optimal switching strategy is difficult to implement, suboptimal switching strategies are also considered. Control strategies are evaluated through digital and analog simulation of one and two machine test systems as well as a full-scale ten machine test system. Methods for obtaining dynamic equivalents of groups of generators are used to reduce the number of variables necessary for calculating a control.

25870 **(DOE/ET/29365—9) Phase rotation as a means of augmenting transient stability.** (Purdue Univ., Lafayette, IN (USA)). Sep 1980. Contract AC01-79ET29365. 82p. NTIS, PC A05; 3; GPO Dep. Order Number DE84010339.

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As turbine generators become larger, their per-unit inertias decrease and their transient reactances increase. The result is reduced transient stability which must be augmented by supplementary techniques of transient stability enhancement. 120° phase rotation with immediate fast valving is shown to be a very effective means of augmenting transient stability when controlled by generator rotor angle. Variations, involving delay of fast valving or 360° phase rotation or multiple 120° phase rotation, are also studied. Comparisons, between these methods of augmenting transient stability, are made on the basis of transient stability enhancement and torsional shaft stress characteristics.

25871 **(DOE/ET/29365—10) Reactive power control to alleviate bus voltage violations in an ac-dc power system.** (Purdue Univ., Lafayette, IN (USA)). Dec 1983. Contract AC01-79ET29365. 128p. NTIS, PC A07; 3; GPO Dep. Order Number DE84010329.

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Multiterminal dc system offers operational advantages in network reactive power flow control. The var control capabilities of the dc system is of particular interest in this thesis. This thesis presents a formulation for coordinating multiterminal dc systems in connection with the conventional reactive power sources to correct bus voltage violations in the ac network as a sequence of Linear Programming (LP) subproblems. Using this formulation a number of algorithms for obtaining the desired controls are investigated. The usefulness of the dc system for reactive compensation especially during light load periods is demonstrated. The basic algorithm which uses a dual LP technique and based on the full linear model is found to be not suitable for large ac-dc power system because of the considerable computation time required to obtain the controls. Simplifying the full model by taking advantage of the approximate decoupled relationship between the real and reactive power components and using a dual simplex type LP technique, a much faster algorithm is developed.

25872 **(DOE/FE—0038) Coal-mixture fuels for utility and industrial applications.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Management, Planning and Technical Coordination). May 1984. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009879.

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In support of DOE/FE's Office of Planning and Environment, MITRE has reviewed the technology status and potential economic and strategic impact of coal-mixture fuels for displacing the use of premium fuels in utility and industrial applications. The major contribution of this effort to DOE's mission has been the development of a series of analytical models for estimating the performance (efficiency, emissions, auxiliary power needs), capital cost, and levelized, life-cycle cost of product (electricity or steam) for utility steam power plants and industrial steam boilers. Inputs for the analysis include: fuel composition and cost; combustion parameters; plant size; emissions control strategy (equipment); and, financial parameters. MITRE's analysis shows coal-oil and coal-water mixtures to offer substantial (10 to 30%) savings in levelized cost of electricity when retrofitted to existing oil-fired utility power plants; for large industrial boilers, coal-mixture retrofits are shown to yield savings of 8 to 19% in the levelized cost of steam. For new industrial steam plants, coal-water mixtures can offer significant (20%) savings over oil-fired alternatives. The projected economic benefits of coal-mixtures are shown to depend on two assumptions: (1) that the real escalation rate for oil prices over the plant lifetime is two (2) percentage points greater than that for coal; (2) that stack gas scrubbing will not be required for the coal-mixture-fueled plants. For new utility plants, it will be difficult for coal-water mixtures, even without stack gas scrubbers, to compete with new, more conventional coal-fired plants with scrubbers. 28 references, 14 figures, 21 tables.

25873 **(EUR—8764-EN) Optimisation of a multi-vane expander as the prime-mover in an organic Rankine cycle.** O'Callaghan, P.W.; Wood, R.J.; Bell, M.A.; Hussein, M.; Patel, R.M.; Buick, T.R.; Probert, S.D. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1983. 188p. Commission of the European Communities, Luxembourg.

Extensive practical testing and computer modelling of two types of multi-vane expander has been accomplished. Conventional and lobe-type multi-vane expanders of 3-6 KW shaft power were tested using R11, steam, R113 and air as working fluids. Expander efficiencies of 65% (conventional) and 48% (lobe) have been measured. From computer simulations realistic target efficiencies of between 70-80% or better should be attainable. The major parameters affecting the performance of a multi-vane expander are the mechanical efficiency and parasitic leakage coefficient. These in turn depend on various design and operating criteria which are specified in detail. Particular emphasis is laid on the need for effective internal sealing to maintain low parasitic leakage. Optimisation of the complete Rankine cycle shows that for a fixed inlet and outlet pressure an optimum volume ratio exists based on a trade-off between the cut-off efficiency and the mechanical efficiency. Where no restraint is placed on the inlet pressure an optimum inlet pressure exists (together with an optimum volume ratio) based on a trade-off between the ideal cycle efficiency and the parasitic leakage coefficient. The multivane expander has shown itself to be a rugged and reliable expansion device. It is flexible and versatile and with careful design and construction is capable of achieving high efficiencies. Its incorporation into Rankine-cycle driven heat pumps, waste heat generation sets and solar thermo-mechanical converters is both feasible and practicable and further research and development along these lines is likely to be of immense value.

25874 **Pacing plant motors for energy savings.** Lihach, N.; Ferraro, R. *EPRI (Electric Power Research Institute) Journal;* **9**: No. 2, 22-28(Mar 1984).

Electronic adjustable-speed drives (ASDs) allow power plant auxiliary motors to work only as hard as they need to. In some cases, ASDs can reduce energy requirements by 30-50%, while minimizing wear and tear. Electronic ASDs' advanced hardware and software make them more compact than their mechanical counterparts, so retrofits are a relatively simple undertaking. Electric Power Research Institute studies include development and testing on ASDs retrofits and seeking new applications. 2 references, 6 figures.

25875 **Fully synthetic taped insulation cables.** Forsyth, E.B.; Muller, A.C. (to Dept. of Energy). US Patent Application 6-514,127. 15 Jul 1983. 15p. Contract AC02-76CH00016.

The present invention is a cable which, although constructed from inexpensive polyolefin tapes and using typical impregnating oils, furnishes high voltage capability up to 765 kV, and has such excellent dielectric characteristics and heat transfer properties that it is capable of operation at capacities equal to or higher than presently available cables at a given voltage. This is accomplished by using polyethylene, polybutene or polypropylene insulating tape which has been specially processed to attain properties which are not generally found in these materials, but are required for their use in impregnated electrical cables. Chief among these properties is compatibility with impregnating oil.

25876 **Simple test for dissimilar-metal welds.** Klueh, R.L.; King, J.F.; Griffith, J.L. (Oak Ridge National Lab., TN). *Welding Research (Miami);* 154S-159S(Jun 1983). Contract W-7405-ENG-26.

A simplified accelerated test procedure has been developed for testing dissimilar-metal welds between austenitic stainless steels and low-alloy ferritic steels. The failure of these welded joints in operating steam generators of fossil-fired power plants has become an increasing problem for the utility industry. The proposed test is a three-point loading, bent-beam test that uses sheet specimens taken from a dissimilar-metal weldment. Tests were conducted in a simple test fixture where the specimens are loaded with a set-screw. To determine whether the test produces the same type of failure as those produced in a power plant, tests were conducted on specimens taken from a weld between Type 316 stainless steel and 2 1/4 Cr-1 Mo steel plates using Type 309 stainless steel filler metal. The specimens were loaded in the test fixture at room temperature and then thermally cycled between room temperature and 593°C (1099°F) by placing the test apparatus in a box furnace (thermal cycling during power plant operation plays a major role in the weld failure during service). The specimens were kept in the furnace for 20 to 70 hours (h), cooled to room temperature, and then the cycle was repeated. Metallographic examination of specimens cycled as few as 64 times with a total of 2300 h at 593°C revealed that the specimens contained cracks similar to the cracks observed on dissimilar-metal welds cut from steam tubes after long-time elevated-temperature service racks similar to the cracks observed on dissimilar-metal welds cut from steam tubes after longtime elevated-temperature service in a fossil-fired steam generator. All indications are that this simple accelerated test could be used as a screening procedure to compare the relative behavior of "improved" welds in future research and development programs.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 25254, 27161

25877 **PCB Detection in the field.** Douglas, J.; Tahiliani, V.; Kormai, R. *EPRI (Electric Power Research Institute) Journal;* 9: No. 2, 29-33(Mar 1984).

Testing for polychlorinated biphenyl (PCB) contamination in the nation's 35 million transformers is an expensive and time-consuming prospect for utilities. Four new devices developed specifically for field use should speed the process and lower the cost. The new techniques are a small chemical test kit, a portable instrument based on X-ray fluorescence, an automated infrared spectrometer, and an improved gas chromatograph. The chemical kit is the handiest of the four. 4 figures.

25878 **Impingement losses of white perch at Hudson River power plants: magnitude and biological significance.** Barnthouse, L.W.; Van Winkle, W.; Vaughan, D.S. (Oak Ridge National Lab., TN). *Environmental Management;* 7: No. 4, 355-364(1983). Contract W-7405-ENG-26.

A quantitative assessment of the impact of impingement at power plants on the Hudson River white perch population was made. It was estimated that impingement reduces the abundance of each white perch year class by at least 10% and probably by 15-20% or more after 2-3 years of vulnerability to power plants. Effects of impingement on average year-class abundance of white perch could not be detected from a time series of abundance indices derived from impingement data. Even if a reliable index were developed, natural fluctuations in year-class strength are great enough that a short-term monitoring program would be inadequate for detecting even a large reduction in average year-class strength. A multipopulation analysis was performed using simple food chain and food web models. The results suggest that any long-term decline in white perch abundance caused by impingement should be accompanied by an increase in the biomass of adult white perch relative to young-of-the-year. It was concluded that (1) at present, assessments of population-level impact of impingement should focus on short-term effects, (2) research is needed to develop a reliable index of year-class strength for use in long-term monitoring programs, (3) identification and quantification of natural environmental factors influencing year-class strength are needed to improve the ability to predict and detect changes in abundance, and (4) it would be useful in designing monitoring programs to focus on detecting patterns of change among populations and age groups rather than solely on declines in abundance of individual populations. 24 references, 5 figures, 3 tables.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 27091, 27094, 27095

25879 **(DOE/CS/15074—T4) Energy Conservative Cable System Demonstration Project. Technical progress report, December 8, 1983-April 14, 1984.** (Pugh (Paul F.) and Associated Professional Engineers, Oakland, CA (USA). Energy Conservative Cable Dept.). 14 Apr 1984. Contract FG01-81CS15074. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008982.

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This is a short report reviewing the technical progress testing of a energy conservative cable system. Test results are given.

25880 **(FERMILAB/TM—1252) Design note about a 75 KVA quiet power distribution system.** Visser, A.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 5 Apr 1984. Contract AC02-76CH03000. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010878.

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This note describes a 75KVA quiet power distribution system for X 653 in neutrino Lab D. It is fed from the regular AC distribution which exists in the building and it has no standby power. Its purpose is to remove electrical disturbances which are present on the regular AC distribution.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 26157

25881 **(NUREG/CR—3637) Application of Stein and related parametric empirical Bayes estimators to the nuclear plant reliability data system.** Hill, J.R.; Heger, A.S.; Koen, B.V. (Texas Univ., Austin (USA); Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 41p. (EGG—2295). NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84008979.

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This report is the result of a preliminary feasibility study of the applicability of Stein and related parametric empirical Bayes (PEB) estimators to the Nuclear Plant Reliability Data System (NPRDS). A new estimator is derived for the means of several independent Poisson distributions with different sampling times. This estimator is applied to data from NPRDS in an attempt to improve failure rate estimation. Theoretical and Monte Carlo results indicate that the new PEB estimator can perform significantly better than the standard maximum likelihood estimator if the estimation of the individual means can be combined through the loss function or through a parametric class of prior distributions.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 25418, 25424, 25440, 25915, 25973, 25981, 25985, 26001, 26003, 26008, 26018, 26020, 26021, 26025, 26026, 26029, 26030, 26033, 26034, 26044, 26047, 26048, 26049, 26051, 26052, 26055, 26601, 26602, 26612

25882 (ANL—83-55, pp 121-137) **Fuels and materials chemistry.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

Information is presented concerning LWR fission product chemistry; reactor safety research; and fusion-related research.

25883 **(CONF-840614—30) Comparison of BIASI and Columbia CHF correlations using BODYFIT-2PE.** Chen, B.C.J.; Chien, T.H.; Sha, W.T.; Kim, J.H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006598.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

This paper compares the BIASI critical heat flux (CHF) correlation with the Columbia CHF correlation by using both the homogeneous equilibrium two-phase model with algebraic slip and the drift flux model in BODYFIT-2PE. All calculations were compared with the GE 3 x 3 CHF experiment. This comparison serves as a qualification process for the CHF correlations in the framework of BODYFIT-2PE.

25884 **(DOE/ET/34006—13) Extended Burnup Demonstration Reactor Fuel Program. Poolside fuel examination, Big Rock Point extended burnup fuel, February 1982 (EOC 17).** Exarhos, C.A. (Consumers Power Co., Jackson, MI (USA); Exxon Nuclear Co., Inc., Richland, WA (USA); GPU Nuclear Corp., Parsippany, NJ (USA)). 29 Mar 1984. Contract AC02-79ET34006. 93p. (XN-NF—83-80). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. Order Number DE84010631.

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The US Department of Energy, Consumers Power Company, Exxon Nuclear Company, and GPU Nuclear have participated since 1979 in a cooperative Extended Burnup Demonstration program. Under the program, standard ENC-fabricated reload fuel in the Big Rock Point and Oyster Creek cores is to be irradiated to discharge burnups in excess of 35,000 MWD/MTU, one to two cycles beyond its originally projected exposure life. The program provides for examination of the fuel at poolside before and after each extended burnup cycle as well as for limited destructive examination in hot cells. This report documents the results of the 1982 fuel examination conducted on the Big Rock Point EBD fuel at EOC 17 in February 1982. The fuel had reached an average exposure of 39,300 MWD/MTU, completing the irradiation phase of the Big Rock Point EBD program. Measurements of fuel rod diameter and rod length were obtained on 59 EBD rods in two assemblies, supplemented by eddy current testing and visual inspection. The rods were found to be in excellent condition, with no evidence of accelerated deterioration despite their high exposure. The EBD program at Big Rock Point has successfully demonstrated the suitability of the fuel for extended irradiation while providing a detailed data base for future study.

25885 **(EGG-PBS—6554) Improved time integration method for the TRAC-BD1 analytic nodal reactor kinetics equations.** Nigg, D.W.; Putnam, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011182.

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This report documents an improved time integration method developed for use with the TRAC-BD1 space-dependent reactor kinetics package. To obtain comparable accuracy, the new method allows the use of significantly larger neutronic time integration steps than allowed by the traditional theta-differencing method that was originally employed in the TRAC-BD1 neutronic routines. Results of several numerical experiments indicate that time step size increases of an order of magnitude or more are possible for most applications. This provides a corresponding decrease in execution time for the TRAC-BD1 nodal kinetics routines when running under automatic time step control.

25886 **(EIR—431) Identification of the two-phase flow in the upper part of a boiling water reactor core using reactor noise analysis.** Miteff, L. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1983. 154p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84700951.

The starting point of this work were neutron flux correlation measurements in the core of the Muehleberg boiling water reactor. During these measurements a new effect was observed i.e. that the cross power spectral density (CPSD) phases could be approximated by two straight lines of different slopes. The two linear domains of the CPSD-phases are separated along the frequency axis by a transition interval. It was supposed that such CPSD-phases could account for the propagation in the axial direction of two different thermohydraulic perturbations in the upper part of the Muehleberg BWR core. It was also assumed that the second linear domain of these CPSD-phases could be related to a characteristic property of an annular flow regime of the steam-water two-phase flows in the bundles around the neutron detectors. The author attempts to give an explanation for the existence of a second transport phenomenon. This was achieved by in-core and out-core correlation measurements as well as by theoretical work. The out-core measurements were performed on an water-air simulation loop by use of laser beams.

25887 **(EUR—7879) Benchmark reference data on post irradiation analysis of light water reactor fuel samples.** Guardini, S.; Guzzi, G. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 162p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE84700965.

The structure of the present report is as follows: in section I the benchmark activity is described in detail, characteristics of the reactors and fuel assemblies examinated are given, and the technical aspects of the chemical and analytical processes are discussed. In section II all the techniques used to certify the analytical data are presented, together with a discussion of evaluated random and systematic uncertainties. A comparison with the calculated values and the interpretation with isotopic correlation techniques is also presented in this section. Section III presents the results. In practice the complete sets of results referring to all Joint Research Centre measurements are given here for the sake of the completeness and consistency of this final report.

25888 **(EUR—8221) Possible research program on a large scale nuclear pressure vessel. Final report.** (Commission of the European Communities, Luxembourg). 1983. 414p. NTIS (US Sales Only), PC A18/MF A01. Order Number DE84700932.

The nuclear pressure vessel structural integrity is actually one of the main items in the nuclear plants safety field. An international study group aimed at investigating the feasibility of a "possible research program" on a scale 1:1 LWR pressure vessel. This report presents the study group's work. The different research programs carried out or being carried out in various countries of the European Community are presented (phase I of the study). The main characteristics of the vessel considered for the program and an evaluation of activities required for making them available are listed. Research topic priorities from the different interested countries are summarized in tables (phase 2); a critical review by the study group of the topic is presented. Then, proposals for possible experimental programs and combination of these programs are presented, only as examples of possible useful research activities. The documents pertaining to the results of phase I inquiry performed by the study group are reported in the appendix.

25889 **(EUR—8344) Use of a heat transfer coefficient for describing the radiative exchange between water vapour and the bounding walls. Final report.** Eifler, W.; Shepherd, I.M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700966.

During the "severe-fuel-damage" experiments of the SUPER SARA test program radiation heat transfer will play an important part. For the analysis of these experiments it should be modelled therefore in a particularly appropriate manner. Based on the same engineering type principles which are used in the radiation model of the TRAC code version for boiling water reactors a new model has been developed. This model is less computer time consuming than the TRAC model and particularly appropriate for the use in the subchannel-type bundle computer code which is planned to be developed for the analysis of the "severe-fuel-damage" experiments. Sample calculations for the "severe-fuel-damage" test array show that the difference between the results obtained with the new model and those obtained with the TRAC model is in general not significant.

25890 **(NUREG—1042) Technical specifications: Susquehanna Steam Electric Station, Unit No. 2 (Docket No. 50-388). Appendix A to License No. NPF-22.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1984. 494p. NTIS, PC A21/MF A01 - GPO* $9.50. Order Number DE84900970.

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Susquehanna Steam Electric Station, Unit 2 Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

25891 **(NUREG/CR—3071) Irradiation history and interim postirradiation data for IFA-432.** Lanning, D.D.; Bradley, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 190p. (PNL—4543). NTIS (US Sales Only), PC A09/MF A01; 1 - GPO $6.00; GPO Dep. Order Number DE84009655.

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Preirradiation characterization data and measured in-reactor data are summarized for the six-rod instrumented Halden fuel assembly IFA-432. Postirradiation data are presented on three of the rods - Rods 1, 6, and 8 - from this assembly. Rods 1 and 6 operated from December 1975 to June 1981 and accumulated peak burnups of 34 MWd/kgM. Fuel temperatures, gas pressures, and rod elongation were measured throughout the life of these rods, together with the corresponding power histories. Postirradiation observations on the rods are correlated with their design features and operating history. End-of-life fission gas release data demonstrate the influence of both as-fabricated grain size and the operating history. Rods 1 and 6 experienced classic thermal feedback between fuel temperatures and gas release but had different rates of response, such that they attained lifetime peak temperatures at different burnups. Detailed measurements of the distribution of retained gas were performed on these two rods, and the results are compared with measured and calculated temperatures and with computer code predictions.

25892 **(NUREG/CR—3717) Evaluation of robotic inspection systems at nuclear power plants.** White, J.R.; Eversole, R.E.; Farnstrom, K.A.; Harvey, H.W.; Martin, H.L. (Remote Technology Corp., Oak Ridge, TN (USA)). Mar 1984. 106p. NTIS, PC A06/MF A01 - GPO* $4.75. Order Number DE84900990.

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This report presents and demonstrates a cost-effective approach for robotics application (CARA) to surveillance and inspection work in existing nuclear power plants. The CARA was developed by the Remote Technology Corporation to systematically determine the specific surveillance/inspection tasks, worker hazards, and access or equipment placement restraints in each of the many individual rooms or areas at a power plant. Guidelines for designing inspection robotics are included and are based upon the modular arrangement of commercially-available sensors and other components. Techniques for maximizing the cost effectiveness of robotics are emphasized in the report including: selection of low-cost robotic components, minimal installation work in plant areas, portable systems for common use in different areas, and standardized robotic modules. Factors considered as benefits are reduced radiation exposure, lower man-hours, shorter power outage, less waste material, and improved worker safety concerns. A partial demonstration of the CARA methodology to the Sequoyah (PWR) and Browns Ferry (BWR) Plants is provided in the report along with specific examples of robotic installations in high potential areas.

25893 **(NUREG/CR—3718) Reliability analysis of stiff versus flexible piping. Status report.** Lu, S.C.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 42p. (UCID—19722). NTIS, PC A03/MF A01; 1 - GPO $3.75; GPO Dep. Order Number DE84010562.

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Conservative design procedures adopted for nuclear piping systems usually result in stiff piping designs that use excessive support devices such as rigid supports and snubbers. Use of these piping support devices has created safety concerns. This report describes the interim result for a piping research project conducted at Lawrence Livermore National Laboratory (LLNL) for the US Nuclear Regulatory Commission (NRC). The overall objective of this research project is to develop modified design requirements and criteria which will improve piping reliability and minimize the use of pipe supports, snubbers, and pipe whip restraints. The current study was conducted to establish the necessary groundwork for this work based on the piping reliability analysis.

25894 **Fuel-cladding mechanical interaction in PCI-resistant LWR fuel designs during normal operation and power ramping.** Barner, J.O.; Freshley, M.D.; Grunther, R.J. (Pacific Northwest Laboratory, P.O. Box 999, Richland, Washington 99352). *Nuclear Technology;* **63**: No. 1, 63-80(Oct 1983).

The fuel cladding mechanical interaction behavior of developmental fuel rods irradiated in the Halden Boiling Water Reactor was evaluated based primarily on rod elongation measurements made during steadystate and power-ramping irradiation. The developmental fuel rod designs were selected based on attributes that were expected to reduce pellet-cladding interaction (PCI) failures during irradiation. Testing results were compared to a nonpressurized reference design with dished-pellet fuel. For the reference rods, there was a relationship between thermal feedback and fuel-cladding mechanical interaction during steady-state irradiation. Significant cladding stresses developed in both the axial and hoop directions in the reference rods during power ramping. During power ramping the general cladding stress distribution in fuel rods with annular fuel pellets was primarily axial while cladding stresses in rods with sphere-pac fuel were mostly in the hoop direction. These results are indicative of superior PCI resistance in the annular pellet fuel rod designs when compared to the reference and sphere-pac rods.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 25418, 25424, 25440, 25500, 25882, 25887, 25888, 25892, 25893, 25955, 25973, 25985, 25999, 26001, 26003, 26005, 26006, 26008, 26010, 26018, 26019, 26020, 26021, 26029, 26035, 26036, 26043, 26044, 26051, 26053, 26055, 26059, 26060, 26061, 26064, 26066, 26601, 26602, 26612

25895 **(BMFT-FB-T—83-311) Utilization of low-temperature heat out of Philippsburg nuclear power plant and concepts for economical district heating systems.** Kaier, U.; Gollas, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 147p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751260.

The project had to develop technical and economical concepts of utilization of low temperature heat and waste heat out of the Philippsburg nuclear power plant. Three general techniques

turned out to be feasible and economical: - District heating for the eastern part of the town by extraction of 18 MW (thermal output) out of the low pressure part of the condensing turbine (total load of the district heating system is 37 MW), - Supply of greenhouses (total area of 20.000 m^2 under glas) close to the plant by waste heat out of the condensing - turbine and generator-cooling-circuit (8 MW, 30°C), - Supply of low-temperature waste heat out of the condensing circuit (4 MW, 20°C) for fish-growing-basins.

25896 **(BNL-NUREG—34244) Benchmarking of pressure vessel fluence calculations.** Cokinos, D.M.; Carew, J.F.; Kohut, P.; Todosow, M. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 6p. (CONF-840614—42). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007375.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Extended neutron irradiation of certain PWR pressure vessels (PVs) causing significant degradation of vessel material mechanical and structural properties, coupled with the concern that in a PWR transient the pressure vessel may be subjected to pressurized thermal shock, has resulted in a need for accurate and well benchmarked calculations of accumulated pressure vessel fluence. This paper presents results of pressure vessel fluence benchmark calculations and comparisons with measurement data, performed as part of the BNL/NRC Pressure Vessel Embrittlement program. The benchmarking effort consisted of calculations of the fast (>1-MeV) neutron fluence for (1) the PV surveillance capsules of two Combustion Engineering reactors (CE-1, a 217-assembly plant, and CE-2, a 133-assembly plant) and a 177-assembly Babcock and Wilcox reactor (B and W-1), (2) flux measurements made in the cavity of a 177-assembly B and W reactor (B and W-2) and (3) the ORNL/PCA benchmark experiment.

25897 (CONF-830528—Vol.2, pp 1501-1504) **Experience in the transport of spent nuclear reactor fuel assemblies.** Sherman, G. Jr. (EG and G, Inc., Idaho Falls, ID); Lopez, C.A.; Neumann, A.T. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This presentation involves a description of our experiences with the transport and storage of spent nuclear reactor fuel assemblies using the dry method. The assemblies involved in our discussion came from pressurized water reactors (PWR).

25898 **(DOE/ET/34013—8) Evaluation and demonstration of methods for improved nuclear fuel utilization: analysis of the transition to extended burnup cycles for ANO-2.** Freeman, R.S.; Greene, M.A.; Decher, U.; Matzie, R.A. (C-E Power Systems, Windsor, CT (USA); Arkansas Power and Light Co., Little Rock (USA)). Oct 1983. Contract AC02-79ET34013. 238p. (CEND—412). NTIS (US Sales Only), PC A11/MF A01; 1; GPO Dep. Order Number DE84010495.

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The objective of this Department of Energy program is to demonstrate increased burnup for Combustion Engineering 16x16 fuel. This extended burnup objective will be realized by demonstrating that advanced fuel designs are capable of increasing batch average discharge exposure to 53 GWD/T and by demonstrating that the current fuel design is capable of increasing batch average discharge exposure to 43 GWD/T. The program includes analyses to assure that the extended burnup objective can be realized with both conventional and low leakage fuel management schemes. This topical report presents the results of the above mentioned analyses. It presents the analyses of various fuel management transitions to extended burnup, 18-month cycles for ANO-2. These analyses were performed to show that no barriers are expected that would prevent implementation of extended burnup cycles. The report collects the fuel management sections of several prior progress reports and completes the overall analysis effort.

25899 **(DOE/ET/34015—7) Evaluation of on-line chelant addition to PWR steam generators. Steam generator cleaning project.** Tvedt, T.J.; Wallace, S.L.; Griffin, F. Jr. (Dow Chemical Co., Freeport, TX (USA)). Sep 1983. Contract AC02-79ET34015. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84008859.

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The investigation of chelating agents for continuous water treatment of secondary loops of PWR steam generators were conducted in two general areas: the study of the chemistry of chelating agents and the study of materials compatability with chelating agents. The thermostability of both EDTA and HEDTA metal chelates in All Volatile Treatment (AVT) water chemistry were shown to be greater than or equal to the thermostability of EDTA metal chelates in phosphate-sulfite water chemistry. HEDTA metal chelates were shown to have a much greater stability than EDTA metal chelates. Using samples taken from the EDTA metal chelate thermostability study and from the Commonwealth Research Corporation (CRC) model steam generators (MSG), EDTA decomposition products were determined. Active metal surfaces were shown to become passivated when exposed to EDTA and HEDTA concentrations as high as 0.1% w/w in AVT. Trace amounts of iron in the water were found to increase the rate of passivation. Material balance and visual inspection data from CRC model steam generators showed that metal was transported through and cleaned from the MSG's. The Inconel 600 tubes of the salt water fouled model steam generators experienced pitting corrosion. Results of this study demonstrates the feasibility of EDTA as an on-line water treatment additive to maintain nuclear steam generators in a clean condition.

25900 **(DOE/ET/34019—4) On-line monitoring of main coolant pump seals.** Stevens, D.M.; Spencer, J.W.; Morris, D.J.; Glass, S.W.; Sommerfield, G.A.; Harrison, D. (Babcock and Wilcox Co., Lynchburg, VA (USA); Toledo Edison Co., OH (USA); USDOE, Washington, DC). Jun 1984. Contract AC02-79ET34019. 15p. (CONF-840647—8). NTIS, PC A02; 3; GPO Dep. Order Number DE84008013.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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The Babcock and Wilcox Company has developed and implemented a Reactor Coolant Pump Monitoring and Diagnostic System (RCPM and DS). The system has been installed at Toledo Edison Company's Davis-Besse Nuclear Power Station Unit 1. The RCPM and PS continuously monitors a number of indicators of pump performance and notifies the plant operator of out-of-tolerance conditions or pump performance trending toward out-of-tolerance conditions. Pump seal parameters being monitored include pump internal pressures, temperatures, and flow rates. Rotordynamic performanvce and plant operating conditions are also measured with a variety of dynamic sensors. This paper describes the implementation of the system and the results of on-line monitoring of four RC pumps.

25901 **(DOE/ET/34212—42) Development of an advanced extended-burnup fuel assembly design incorporating Urania-Gadolinia. Fourth semi-annual progress report, October 1982-March 1983.** Newman, L.W. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Feb 1984. Contract AC02-78ET34212. 89p. (BAW—1681-4). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. Order Number DE84011607.

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This advanced fuel assembly uses a UO_2-Gd_2O_3 burnable-absorber fuel mixture along with other state-of-the-art fuel performance and uranium utilization-enhancing design features that include annular pellets, annealed guide tubes, Zircaloy intermediate grids, and a removable upper end fitting. To provide benchmark and fuel performance data at extended burnup, standard Mark B fuel assemblies are being irradiated and examined after three, four, and five cycles of operation under the latter program. During this reporting period, the following activities were completed: hygroscopic prop-

erties determinations of UO_2-Gd_2O_3, U-238 resonance integral measurements for solid and annular UO_2 and UO_2-Gd_2O_3 fuel pellets, critical experiments using 15x15 and 16x16 (large waterhole) assembly lattice configurations, lead test assembly (LTA) prototype testing, and fabrication of the LTA UO_2-Gd_2O_3 fuel pellets. The continuing activities during this period included fabricating the intercalibrated movable incore detector system, irradiating a standard Mark B fuel assembly for a fifth cycle, and measuring cladding waterside oxide-thickness on standard Mark B fuel rods.

25902 **(DOE/ET/34213—11) Development of an extended-burnup Mark B design. Eighth progress report, July 1982-June 1983.** Coleman, T.A.; Pyecha, T.D. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Mar 1984. Contract AC02-78ET34213. 60p. (BAW—1532-8). NTIS (US Sales Only), PC A04/MF A01; 1; GPO Dep. Order Number DE84011605.

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Four lead test assemblies of an advanced extended-burnup design have been manufactured and characterized and are being irradiated in the Arkansas Nuclear One, Unit 1 (ANO-1) pressurized water reactor. During this period, four extended-burnup lead test assemblies (Mark BEBs) completed their first cycle of irradiation in cycle 5 of ANO-1. The Mark BEBs achieved an average burnup of 18,060 MWd/mtU in cycle 5, which began on March 16, 1981 and ended on November 8, 1982. Two Mark BEBs and two baseline Mark B assemblies were nondestructively examined on site during the refueling outage at the end of cycle 5. The assemblies were in excellent condition and were returned to the core for continued irradiation. Cycle 6 of ANO-1, the second cycle of irradiation for the lead test assemblies, began on April 7, 1983. As of June 30, 1983, the Mark BEB assemblies have accumulated a burnup of 18,700 MWd/mtU.

25903 **(DOE/RL/10153—T1-Vol.1) Shippingport Station Decommissioning Project decommissioning plan. Volume I.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). Sep 1983. Contract AC06-80RL10153. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010909.

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Information is presented concerning the organization of the decommissioning project; decommissioning operations concept; safety and environmental assessment; information and guidance for the DOC; work breakdown structure; decommissioning operation schedule; decommissiong operations estimate; and training requirements.

25904 **(DOE/RL/10153—T1-Vol.2) Shippingport Station Decommissioning Project decommissioning plan. Volume II.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1983. Contract AC06-80RL10153. 274p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84010916.

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This volume appendix on activity specifications is divided into the following: site preparation; barge loading facility; facility closeout and restoration; preparation for removal of reactor pressure vessel, internals, and neutron shield tank package; heavy lifting and hauling; barge transportation; and Hanford transportation. (DLC)

25905 **(DOE/RL/10153—T1-Vol.3) Shippingport Station Decommissioning Project decommissioning plan. Volume 3.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). Aug 1983. Contract AC06-80RL10153. 377p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE84010915.

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Information is presented concerning the removal of both contaminated and non-contaminated piping and equipment from the Shippingport reactor.

25906 **(DOE/RL/10153—T1-Vol.4) Shippingport Station Decommissioning Project decommissioning plan. Volume IV.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1983. Contract AC06-80RL10153. 395p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE84010914.

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Information is presented concerning the removal of primary system components; removal of power and control systems; removal of contaminated concrete; removal of non-contaminated structures; removal of containment vessel chambers; liquid waste management; dewatering and removal of spent resins utilizing high integrity containers; liquid waste processing; and solidification of radioactive wastes.

25907 **(DOE/RL/10153—T1-Vol.7) Shippingport Station Decommissioning Project decommissioning plan. Volume VII.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1983. Contract AC06-80RL10153. 425p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE84010911.

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Schedules are presented for removal of piping and equipment; removal of primary system components; removal of power and control systems; removal of contaminated concrete; removal of non-contaminated structures; removal of containment vessel chambers; liquid waste management; solid waste management; decontamination; and systems operation support.

25908 **(DOE/RL/10153—T1-Vol.10) Shipppingport Station Decommissioning Project decommissioning plan. Volume 10.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). 1983. Contract AC06-80RL10153. 502p. NTIS, PC A22; 3; GPO Dep. Order Number DE84010905.

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Appendices are presented concerning activation analysis; reactor and intervals removal; reactor vessel removal; escalation effects; removal of contaminated concrete; and removal of contaminated chanbers.

25909 **(DOE/RL/10153—T1-Vol.12) Shippingport Station Decommissioning Project decommissioning plan. Volume XII.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1983. Contract AC06-80RL10153. 385p. NTIS, PC A17; 3; GPO Dep. Order Number DE84010917.

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Information is presented concerning allowable residual contamination levels in soil for decommissioning the Shippingport reactor site; draft statement of work for the decommissioning operations contractor; the Shippingport Station Decommissioning Project Change Control Board charter; the surplus facilities management program; the Shippingport Station Decommissioning Project charter; DOE-RL/DOE-PNR program management agreement; and draft occupational medical plan for the decommissioning project.

25910 **(DOE/RL/10153—Vol.11-Pt.2) Shippingport Station Decommissioning Project decommissioning plan. Part 2. Volume 11.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). 1983. Contract AC06-80RL10153. 315p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84010659.

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Information is presented concerning the cost-benefit analysis for decontamination of the Shippingport reactor and radiation-contamination survey data.

25911 **(EGG-MS—6522) Uranium recovery from a nuclear fuel.** Miller, R.L.; Welch, J.M.; Flinn, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1984. Contract AC07-76ID01570. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011363.

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Two samples of iron enriched basalt (IEB) containing simulated nuclear fuel and having two distinct microstructures were prepared and tested for uranium recovery. The IEBs are refractory toward leaching by ground water. However, the uranium content (15.8%) is high enough that if aggressive leaching techniques are used for uranium recovery, these materials could be considered as man-made uranium ores. The IEBs discussed in this report were prepared to simulate Three Mile Island-2 core debris. The crushed IEBs were treated using three different methods simulating potential industrial scale processes. In one method the IEBs were fused with sodium hydroxide then the cooled mass leached first with water then with dilute sulfuric acid; about 52% of the uranium was recovered in this case. In the second method the IEBs were treated with a sulfuric acid/hydrogen peroxide lixiviant and about 13% of the uranium was recovered. In the third technique the IEBs were leached with a sodium carbonate/sodium bicarbonate/hydrogen peroxide solution. Only about 0.1% of the uranium was recovered. Results of these screening tests suggest that the IEBs can be successfully treated for recovery of the contained uranium.

25912 **(GEND—039) TMI-2 Technical Information and Examination Program 1983 annual report.** Scardena, D.E. (ed.). (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010392.

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The Department of Energy's Technical Information and Examination Program at Three Mile Island Unit 2 continued the research and development work begun on the Island in 1980. The work concentrated in six major areas: waste immobilization, reactor evaluation, data acquisition, information and industry coordination, core activities, and EPICOR II and waste research and disposition. The program assists in resolving specific problems at TMI-2 while developing techniques and broadening understanding of accident consequences to improve the overall safety and reliability of nuclear power. The Technical Information and Examination Program aims to communicate applicable information to the nuclear power industry to ensure that the industry can avail itself to the maximum amount of information possible.

25913 **(NUREG/CR—3200-Vol.3) Eddy-current inspection for steam generator tubing program. Quarterly progress report for period ending September 30, 1983.** Dodd, C.V.; Deeds, W.E.; Smith, J.H.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract W-7405-ENG-26. 21p. (ORNL/TM—8796/V3). NTIS, PC A02/MF A01 - GPO; GPO Dep. Order Number DE84008009.

Eddy-current inspection is the most suitable method for rapid boreside evaluation of steam generator tubing. However, small flaws can be masked by the effects of harmless variables such as tube supports. To identify the critical properties accurately and reliably in the presence of extraneous signals caused by variations of unimportant properties, sufficient information is needed to identify harmful variations and to reject harmless ones. For this reason instrumentation has been developed which is capable of measuring both the amplitude and phase of the eddy-current signal at several different frequencies as well as computer equipment capable of processing the data quickly and reliably. The most recent computer-optimized probe design uses an array of small flat pancake coils pressed against the inside wall of the steam generator tubing. Data have been taken with such coils on tubes with various combinations of abnormalities. Data were also taken for machined defects in tubes and flat plates to verify the basic flaw theory and to check the inversion theory for characterizing flaw properties from scans across the defect.

25914 **(NUREG/CR—3581) Steam Generator Group Project. Annual report, 1982.** Clark, R.A.; Lewis, M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 121p. (PNL—4693). NTIS, PC A06/MF A01; 1 - GPO $4.75; GPO Dep. Order Number DE84011714.

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The Steam Generator Group Project (SGGP) is an NRC program joined by additional sponsors. The SGGP utilizes a steam generator removed from service at a nuclear plant (Surry 2) as a vehicle for research on a variety of safety and reliability issues. This report is an annual summary of progress of the program for 1982. Information is presented on the Steam Generator Examination Facility (SGEF), especially designed and constructed for this research. Loading of the generator into the SGEF is then discussed. The report then presents radiological field mapping results and personnel exposure monitoring. This is followed by information on field reduction achieved by channel head decontaminations. The report then presents results of a secondary side examination through shell penetrations placed prior to transport, confirming no change in generator condition due to transport. Decontamination of the channel head is discussed followed by plans for eddy current testing and removal of the plugs placed during service. Results of a preliminary profilometry examination are then provided.

25915 **(ORNL/TM—8729) Evaluation of inorganic sorbent treatment for LWR coolant process streams.** Roddy, J.W. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011818.

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This report presents results of a survey of the literature and of experience at selected nuclear installations to provide information on the feasibility of replacing organic ion exchangers with inorganic sorbents at light-water-cooled nuclear power plants. Radioactive contents of the various streams in boiling water reactors and pressurized water reactors were examined. In addition, the methods and performances of current methods used for controlling water quality at these plants were evaluated. The study also includes a brief review of the physical and chemical properties of selected inorganic sorbents. Some attributes of inorganic sorbents would be useful in processing light water reactor (LWR) streams. The inorganic resins are highly resistant to damage from ionizing radiation, and their exchange capacities are generally equivalent to those of organic ion exchangers. However, they are more limited in application, and there are problems with physical integrity, especially in acidic solutions. Research is also needed in the areas of selectivity and anion removal before inorganic sorbents can be considered as replacements for the synthetic organic resins presently used in LWRs. 11 figures, 14 tables.

25916 **(DOE/RL/10153—T1-Vol.6-Pt.2) Shippingport Station Decommissioning Project decommissioning plan. Volume VI, Part II.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1984. Contract AC06-80RL10153. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010904.

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This document comprises the following: report of remaining contractor work, predecessor/successor logic report, contractor interface report (incoming and outgoing interfaces), and activity specification Barchart plot. (DLC)

25917 **Reactor vessels and safety.** *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 80-82(Fal 1983).

As water-cooled nuclear power plants age, several materials problems may occur that could adversely affect the safety of these commercial power plants. Such problems involve the vessel that contains the nuclear fuel core. After long-term exposure to radiation, the steel alloys that make up the pressure vessel may become brittle, and the tendency to crack is enhanced if tiny flaws were originally present. ORNL's studies on thermal shock in PWR pressure vessels are discussed.

25918 **(DOE/RL/10153—T1-Vol.9-Pt.1) Safety analysis for Shippingport Station Decommissioning Project. Vol.9. Pt.1. Rev.1.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). Sep 1983. Contract AC06-80RL10153. 289p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE84010907.

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Information is presented concerning the safety analysis for the decommissioning project; and permitting plan.

25919 **(DOE/RL/10153—T1-Vol.6-Pt.1) Shippingport Station Decommissioning Project decommissioning plan. Part 2. Volume 6.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). 1983. Contract AC06-80RL10153. 312p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84010910.

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Information is presented concerning resource leveled logic report; report of remaining area work; activity specification schedules; and DOC activities.

25920 **(DOE/RL/10153—T1-Vol.9-Pt.2) Shippingport Station Decommissioning Project decommissioning plan. Part 2. Volume 9.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). 1983. Contract AC06-80RL10153. 428p. NTIS, PC A19; 3; GPO Dep. Order Number DE84010906.

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Appendices are included with information concerning DOE order 5480.1A on environmental protection and health protection; 29 CFR 1910.1001 and 40CFR61 concerning asbestos; Corps of Engineers permit information; Pennsylvania air standards; Pennsylvania water standards; Pennsylvania solid waste management; erosion control regulations; explosives regulations; and NPDES permit.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 25442, 25958, 25983, 26009, 26444, 26445, 26446, 26447, 26448

25921 **(GA-A—17351) Effect of inlet and outlet shellside flow and heat transfer on the performance of HTGR straight tube heat exchangers.** Carosella, D.P. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1984. Contract AT03-84SF11962. 11p. (CONF-8404125—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009865.

From IAEA specialists' meeting on heat exchanger components for gas cooled reactors; Dusseldorf, F.R. Germany (16 Apr 1984).

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Since the mid-1970s, various high temperature gas-cooled reactor (HTGR) steam generator, auxiliary heat exchanger (AHE), recuperator, and intermediate heat exchanger (IHX) designs have been proposed that use straight tube configurations. Each of these designs requires 90-deg turns in the helium gas flow at the inlet and/or outlet of the tube bundle. To evaluate the effect of these turns on the tube bundle performance, two model air flow tests have been performed, and a third is being planned. Fluid flow and heat transfer computer models have also been used to try to determine the effect of these 90-deg turns on the tube bundle performance.

25922 **(GA-A—17460) Effect of creep-fatigue damage relationships upon HTGR heat exchanger design.** Kozina, M.M.; King, J.H.; Basol, M. (GA Technologies, Inc., San Diego, CA (USA); Combustion Engineering, Inc., Chattanooga, TN (USA)). Apr 1984. Contract AT03-84SF11963. 13p. (CONF-8404125—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008856.

From IAEA specialists' meeting on heat exchanger components for gas cooled reactors; Dusseldorf, F.R. Germany (16 Apr 1984).

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Materials for heat exchangers in the high temperature gas-cooled reactor (HTGR) are subjected to cyclic loading, extending the necessity to design against fatigue failure into the temperature region where creep processes become significant. Therefore, the fatigue life must be considered in terms of creep-fatigue interaction. The HTGR-SC/C steam generator, a once-through type, is comprised of an economizer-evaporator-superheater (ESS) helical bundle of 2-1/4 Cr-1 Mo tubes followed by a superheater of straight tubes of Alloy 800H in the central zone of the steam generator. The high-temperature components affected by creep-fatigue interaction are the tubing and the superheated steam tubesheet of Alloy 800H. The effects of the revised creep-fatigue damage relationships were evaluated by: (1) calculating the temperature-dependent allowable strain range with the assumed bilinear damage relationship for Alloy 800H; (2) calculating the temperature-dependent allowable strain range with reduced fatigue allowables for 2-1/4 Cr-1 Mo; and (3) predicting the strain range in the critical parts by extrapolation of finite element calculations for the second or last cycle analyzed for each transient to the expected number of cycles and hold times.

25923 **(GA-A—17526) Friction and wear behavior of Inconel 625 with Ni_3Ti, TiN, TiC-CVD coatings in an HTGR environment.** Sarosiek, A.M.; Li, C.C. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1984. Contract AT03-84SF11962. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011324.

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The following conclusions apply to Inconel 625 with Ni_3Ti, TiN, TiC-CVD coatings, tested in an HTGR environment in a temperature range between 500 and 900°C at a contact pressure of 3.45 MPa. The average wear rate is very small varying between 0.0 and 1.7×10^{-4} g/m. The wear rate shows little dependence on temperature and sliding velocity, increasing slightly as the temperature increases or as the sliding velocity decreases. Damage experienced by wear areas is minimal. Stick-slip friction was observed at low sliding velocity, however the friction coefficient is low (maximum 0.63) with an average value of about 0.44. The friction coefficient shows little dependence on temperature and sliding velocity, increasing slightly as the temperature increases, or as the sliding velocity decreases. Ni_3Ti, TiN, TiC-CVD coatings, are considered effective in minimizing friction and wear damage of Inconel 625 in an HTGR environment.

25924 (INIS-SU—203, pp 82-89) **Loop and capsule in pile devices for irradiation studies of high-temperature resistant materials.** Vlasov, K.P.; Yakubov, V.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

A complex system for in pile studies of high-temperature resistant materials for high-temperature gas cooled reactors has been worked out and tested in loops and irradiation capsules of the WWR-SM and IWW-2M reactors. The system involves a set of experimental channels and capsules allowing detailed studies of materials and samples under the conditions most closely simulating the operational ones. The system enables the measurements of creep, electrical conductivity, radiation resistance, swelling of samples and fuel-can systems under increased burnups. The developed system may be recommended for performing similar studies in other research reactors.

25925 (Juel-Conf—36, pp 3-5) **Suitability tests for HTR reflector graphites.** O'Connor, M.F.; Haag, G.; Eatherly, W.P.; Kennedy, C.R. May 1980. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

In a series of experiments in the High Flux Isotopes Reactor, Oak Ridge, the irradiation behaviour of six nuclear graphites was studied at 600°C up to a neutron fluence of 2.0×10^{22} cm^{-2} EDN. The lifetime fluence for each graphite which varied between 1.3×10^{22} cm^{-2} EDN and 1.7×10^{22} cm^{-2} EDN could be categorised according to the method of graphite manufacture, the extruded graphite exhibiting the most favourable lifetime performance. Experiments being conducted using the same graphites in the High Flux Reactor, Petten, show that the measured irradiation-induced dimensional changes during the graphite densification phase are insensitive to flux density changes.

25926 (Juel-Conf—36, pp 14-17) **FRG/US - cooperation on the characterization of reactor graphites.** O'Connor, M.F.; Engle, G.B.; Beavan, L.A.; Burnette, R.D.; Eatherly, W.P.; Cundy, M.R. May 1980. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

Although different high temperature reactor concepts are being followed in the Federal Republic of Germany and the United States, it has been possible to cooperate in the field of the characterization of reactor graphites. Initial results from joint projects to study irradiation-induced creep and oxidation are discussed. It is hoped that strength investigations presently being conducted will lead to a joint definition of criteria for support column selection.

25927 (Juel-Conf—36, pp 35-47) **Material properties and fission product reduction of SiC coatings.** Benz, R.; Foerthmann, R.; Gyarmati, E.; Krautwasser, P.; Naoumidis, A. May 1980. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

Two new methods are described to characterize pyrolytically deposited SiC coatings which are provided to pyrocarbon coated fuel particles as an additional diffusion barrier for solid fission products. The first is based upon a determination of the concentration of imperfections in the SiC structure from measurements of small-angle X-ray scattering intensities (SAXS) and the second is based upon measurements of rates of SiC decomposition at very high temperatures (>2000°C). The data obtained by both methods show a minimum with SiC which was deposited at low deposition rates and 1500°C. First results of diffusion measurements show a correlation between the new characterization data and the transport behaviour of solid fission products.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 26024, 26611, 26616, 27040

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 25416, 25481, 25961, 25963, 25984, 25988, 26012, 26013, 26014, 26015, 26016, 26017, 26022, 26042, 26046, 26050, 26057, 26068, 26311

25928 (ANL—83-55, pp 108-112) **Sodium technology for fast reactors.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

Information is presented concerning the development of cold traps for LMFBR type reactor intermediate heat transfer systems.

25929 **(BNL-NUREG—34213) TWIST: a Transient Two-dimensional Intra-Subassembly Thermal-Hydraulics model for LMFBRs.** Khatib-Rahbar, M.; Cazzoli, E.G. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-840614—47). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010883.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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It is concluded that due to physical accuracy and numerical efficiency (5 to 10 times faster than real time) of this model, it provides an excellent tool for study of long duration natural circulation transients in LMFBR assemblies.

25930 **(CONF-840412—2) Cost-competitive, inherently safe LMFBR pool plant.** McDonald, J.S.; Brunings, J.E.; Chang, Y.I.; Seidensticker, R.W.; Hren, R.R. (Argonne National Lab., IL (USA); Rockwell International Corp., Canoga Park, CA (USA); Bechtel Group, Inc., San Francisco, CA (USA)). 1984. Contract W-31-109-ENG-38;AT03-83SF11911. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010653.

From American power conference; Chicago, IL, USA (24 Apr 1984).

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The Cost-Competitive, Inherently Safe LMFBR Pool Plant design was prepared in GFY 1983 as a joint effort by Rockwell International and the Argonne National Laboratory with major contributions from the Bechtel Group, Inc.; Combustion Engineering, Inc.; the Chicago Bridge & Iron Company; and the General Electric Company. Using current LMFBR technology, many innovative features were developed and incorporated into the design to meet the ultimate objectives of the Breeder Program, i.e., energy costs competitive with LWRs and inherent safety features to maintain the plant in a safe condition following assumed accidents without requiring operator action. This paper provides a description of the principal features that were incorporated into the design to achieve low cost and inherent safety.

25931 **(CONF-840614—22) Thermal laminarization of a stratified pipe flow.** Oras, J.J.; Kasza, K.E. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006407.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The present work constitutes a new program that grew out of a scoping assessment by ANL to determine the propensity for pipe stratification to occur in the reactor outlet nozzles and hot-leg piping of a generic LMFBR during events producing reverse pipe flow. This paper focuses on the role that thermal buoyancy plays relative to being able to laminarize a turbulent stratified shear zone in a horizontal pipe. The preceeding can influence the behavior of a pipe stratified-backflow-recirculation zone (cold plenum water down into the hot pipe flow) which developes as the result of a temperature difference between the pipe flow and the plenum.

25932 **(CONF-840614—33) Perturbation theory within the framework of a higher-order nodal method.** Lawrence, R.D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006716.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

A perturbation theory has been developed for a higher-order nodal method, and this methodology has been used to compute accurate sodium void worths for a heterogeneous-core fast reactor design. This work also makes possible the development of a consistent quasi-static method for the solution of the time-dependent nodal equations.

25933 **(CONF-840647—11) Comments on US LMFBR steam generator base technology.** Simmons, W.R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009155.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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The development of steam generators for the LMFBR was recognized from the onset by the AEC, now DOE, as a difficult, challenging, and high-priority task. The highly reactive nature of sodium with water/steam requires that the sodium-water/steam boundaries of LMFBR steam generators possess a degree of leak-tightness reliability not normally attempted on a commercial scale. In addition, the LMFBR steam generator is subjected to high fluid temperatures and severe thermal transients. These requirements place great demand on materials, fabrication processes, and inspection methods; and even greater demands on the designer to provide steam generators that can meet these demanding requirements, be fabricated without unreasonable shop requirements, and tolerate off-normal effects.

25934 **(DOE/CL/11200—T6) Comparison of CRBRP standards to DOE prescribed standards.** Ogg, W.W.; Copeland, G.S. (Project Management Corp., Oak Ridge, TN (USA)). 2 Sep 1983. Contract AC15-76CL11200. 122p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84006607.

The tables list standards committed to by CRBRP in its design documents, its Environmental Report, and its Preliminary Safety Analysis Report. The compilation of these standards has been placed in column form beside the column of prescribed stand-

ards listed under the various headings of Chapter 1 of DOE's Order 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations. (The DOE standards listed, however, include all those in the other applicable chapters of 5480.1A as mandated in Chapter 1.) There are some CRBRP systems which are impacted very little, if any, by the safety requirements of 5480.1A's prescribed standards. The standards committed to in those systems are, consequently, not included in this comparison. The comparison is made in detail, however, for standards committed to in those systems of CRBRP having areas of safety corresponding to DOE's jurisdiction/requirements as opposed to areas covered only by the USNRC's jurisdiction/regulations. Included in this document are: (1) a table listing titles of the standards not already listed in the comparison table, and (2) a list of acronyms. It seems apparent by the comparison that CRBRP meets the DOE requirement that the Project standards be equal or better (more conservative) than DOE's own prescribed standards.

25935 **(DOE/ER/10025—T2) Government commercialization of large scale technology: the United States Breeder Reactor Program 1964-1976.** Stiefel, M.D. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1981. Contract AT01-79ER10025. 95p. NTIS, PC A05; 3; GPO Dep. Order Number DE84008633.

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The US Liquid Metal Fast Breeder Reactor program was an attempt by the Atomic Energy Commission to develop, in partnership with industry, a particular nuclear technology. Not only did the AEC provide subsidies and test facilities for the private sector, but the agency attempted to direct which technological options would be developed. The national laboratories, nuclear vendors, and electric utilities were not amenable to government direction. The resulting time delays and cost overruns stalled the program until the anti-nuclear movement arose and undermined the political consensus behind the program. As a result, a breeder demonstration plant has not yet been built in the United States. The analysis of this thesis suggests two conclusions. First, future government directed commercialization programs are unlikely to succeed. Second, breeder development should be slowed down until the political problems in the nuclear industry are solved.

25936 **(ESG-DOE—13425) Alternate shield material feasibility.** Specht, E.R.; Levitt, L.B. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1 Apr 1984. Contract AT03-81SF11561. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010412.

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The feasibility and cost/benefit of using materials other than stainless steel for in-vessel neutron shielding in large LMFBRs were investigated. Canned vibratorally compacted B_4C powder shields were found to be much more economical than stainless steel (a savings of $1.1M in loop plant designs and $9.4M in pool plant designs). The helium gas pressure buildup in B_4C shields placed around LMFBR in-vessel components (direct reactor heat exchangers in a loop reactor and intermediate heat exchangers in a pool reactor) would only be 0.04 atm after 40 y of reactor operation (with 80% dense powder). The irradiation-induced swelling of the B_4C would only be 0.002%. No adverse reactor impact would occur if the B_4C escaped from the B_4C shields.

25937 **(EUR—8020) Integral experiment relating to calibration and interpretation of plutonium solid waste measurements at Dounreay nuclear power development establishment.** Bremner, W.B.; Biggs, A.; Birkhoff, G.; Depraz, J.; Barou, J.; Souga, C. (Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements). 1982. 133p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84700973.

This report deals with the following subjects: performance of the Dounreay Nuclear Power Development Establishment (DNPDE) solid waste measurement system; preliminary results from the first PFR fuel reprocessing campaign; interpretational models; and calibration methods. Interpretational models are given for the utilized NDA techniques. The general interpretational model for the passive neutron technique has been numerically evaluated by neutron transport calculations. Calibration procedures are given for the various passive neutron monitors utilized at DNPDE. Mathematical models of the active neutron technique by delayed neutron measurements are also presented.

25938 **(EUR—8357) EURDYN: computer programs for the nonlinear transient analysis of structures submitted to dynamic loading. EURDYN (Release 3): users' manual.** Halleux, J.P. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 154p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE84700988.

The EURDYN computer codes are mainly designed for the simulation of nonlinear dynamic response of fast reactor components submitted to impulse loading due to abnormal working conditions. Two releases of the structural computer codes EURDYN 01 (2-D beams and triangles and axisymmetric conical shells and triangular tores), 02 (axisymmetric and 2-D quadratic isoparametric elements) and 03 (triangular plate elements) have already been produced. They include material (elasto-plasticity using the classical flow theory approach) and geometrical (large displacements and rotations treated by a corotational technique) nonlinearities. The new features of Release 3 roughly consist in: full large strain capability for 9-node isoparametric elements, generalized array dimensions, introduction of the radial return algorithm for elasto-plastic material modelling, extension of the energy check facility to the case of prescribed displacements, and possible interface to a post-processing package including time plot facilities.

25939 **(NE-F—5-10T-2-84) Decontamination of hot leg LMFBR components.** (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76FF02170. 24p. Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831.

This standard establishes process requirements for decontaminating hot leg (between reactor core outlet and intermediate heat exchanger) LMFBR components intended for reuse. The process applies to components made from AISI 304 and 316 stainless steel alloys, their low-carbon analogs (L grades) and CF-8 and CF-8M casting alloys, with nickel-base or cobalt-base hard facing alloys also used, for example, in pump bearings. The hot leg process involves treating the components with a 2.5% glycolic acid - 2.5% citric acid in the range 158 to 194°F (70° to 90°C).

25940 **(WAPD-TM—1421) Nuclear analysis and performance of the Light Water Breeder Reactor (LWBR) core power operation at Shippingport.** Hecker, H.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Apr 1984. Contract AC11-76PN00014. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011834.

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This report presents the nuclear analysis and discusses the performance of the LWBR core at Shippingport during power operation from initial startup through end-of-life at 28,730 EFPH. Core follow depletion calculations confirmed that the reactivity bias and power distributions were well within the uncertainty allowances used in the design and safety analysis of LWBR. The magnitude of the core follow reactivity bias has shown that the calculational models used can predict the behavior of U^{233}-Th systems with closely spaced fuel rod lattices and movable fuel. In addition, the calculated final fissile loading is sufficiently greater than the initial fissile inventory that the measurements to be performed for proof-of-breeding evaluations are expected to confirm that breeding has occurred.

25941 **Clinch River: an alternate financing plan. Hearing before the Subcommittee on Energy Conservation and Power, House of Representatives, Ninety-Eighth Congress, first session, 20 Sep 1983.** Washington, DC; Government Printing Office (1984). 311p.

Representatives of the Clinch River Breeder Reactor (CRBR) project, the nuclear industry, taxpayers, the financial community, and legislators testified at a hearing held to review administration plans for completing the CRBR by attaching its financing to a continuing resolution and avoiding the legislative process. A Con-

gressional Budget Office report noted that the administration's financing proposal will generate up to 37% return on investment from tax relief alone, which is more appropriate for high-risk than government-backed investment. The Congressional Research Service challenged that the plant's power production capacity was overstated and its price overvalued. Of concern to the committee was the fairness of asking taxpayers to share in the $2.5 billion needed to complete the project. Additional material submitted for the record follows the testimony of 20 witnesses.

25942 **Uranium-plutonium carbide fuel for fast breeder reactors.** Matthews, R.B.; Herbst, R.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Nuclear Technology;* **63**: No. 1, 9-23(Oct 1983).

Uranium-plutonium carbide offers an improved fuel system for advanced breeder reactors. The highthermal conductivity and density of carbide fuels permit superior breeding performance and high specific power operation. These advantages combine to increase plutonium production, reduce fuel cycle and power costs, and lower plant capital costs. The carbide advantages are obtained at conservative fuel system design and operating conditions. Carbide fabrication technology has been demonstrated by the production of quality-assured fuel elements for irradiation testing. The carbide irradiation test program has demonstrated that high burnup can be achieved with several designs and that the consequences of postulated off-normal operating events are benign. Design bases to support helium- and sodium-bonded carbide fuel pin test irradiations in the Fast Flux Test Facility have been developed in the Experimental Breeder Reactor and the Transient Reactor irradiation tests.

25943 **Design of D9: a radiation damage-resistant alloy.** Rowcliffe, A. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 60-65(Fal 1983).

The development of breeder reactors has stimulated an intense interest in the behavior of materials subjected to neutron radiation. The goal of the materials development programs has been to generate improved materials that will extend the lifetimes of reactor care components and thereby reduce fuel cycle costs and improve breeding characteristics. ORNL has developed a steel alloy that is resistant to neutron-induced swelling. It could prove useful in ducts and cladding in fuel assemblies in breeder reactors. The ORNL research program on the development of radiation damage-resistant alloys is described.

25944 **Improved gas tagging and cover gas combination for nuclear reactor.** Gross, K.C.; Laug, M.T. (to Dept. of Energy). US Patent Application 6-535,462. 26 Sep 1983. 25p. Contract W-31-109-ENG-38.

The invention discloses the use of stable isotopes of neon and argon, sealed as tags in different cladding nuclear fuel elements to be used in a liquid metal fast breeder reactor. Cladding failure allows fission gases and these tag isotopes to escape and to combine with the cover gas. The isotopes are Ne^{20}, Ne^{21} and Ne^{22} and Ar^{36}, Ar^{38} and Ar^{40}, and the cover gas is He. Serially connected cryogenically operated charcoal beds are used to clean the cover gas and to separate out the tags. The first or cover gas cleanup bed is held between 0 and -25°C to remove the fission gases from the cover gas and tags, and the second or tag recovery system bed between -170 and -185°C to isolate the tags from the cover gas. Spectrometric analysis is used to identify the specific tags that are recovered, and thus the specific leaking fuel element. By cataloging the fuel element tags to the location of the fuel elements in the reactor, the location of the leaking fuel element can then be determined.

25945 **Method for removing cesium from a nuclear reactor coolant.** Colburn, R.P. (to Dept. of Energy). US Patent Application 6-521,815. 10 Aug 1983. 17p. Contract AC06-76FF02170.

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A method of and system for removing cesium from a liquid metal reactor coolant including a carbon packing trap in the primary coolant system for absorbing a major portion of the radioactive cesium from the coolant flowing therethrough at a reduced temperature. A regeneration subloop system having a secondary carbon packing trap is selectively connected to the primary system for isolating the main trap therefrom and connecting it to the regeneration system. Increasing the temperature of the sodium flowing through the primary trap diffuses a portion of the cesium inventory thereof further into the carbon matrix while simultaneously redispersing a portion into the regeneration system for absorption at a reduced temperature by the secondary trap.

25946 **Testing of small-scale cavity closure models in support of development of a 300MW(e) gas-cooled fast breeder reactor.** Naus, D.J.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). *International Journal of Pressure Vessels and Piping;* **14**: No. 1, 1-19(1983).

The Oak Ridge National Laboratory has been involved in design verification and support studies of the prestressed concrete reactor vessel (PCRV) for a 300 MW(e) Gas-Cooled Fast Reactor demonstration power plant. These studies have been related to the design and testing of small-scale models of the steam generator cavity and reactor core cavity closure plugs for the PCRV. The primary objective of these studies was to determine the structural response of the plugs both to normal operating pressure and to substantial overpressurization. Three closure plug models have been tested: a 1/15-scale full-thickness steam generator cavity closure plug, a 1/15-scale half-thickness steam generator cavity closure plug and a 1/20-scale reactor core cavity closure plug. Results obtained indicate that the closure plugs have a significant overload capacity; that is, in excess of 7.5 times the design pressure of the prototype.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 25588, 26170

25947 **(LA-UR—84-1238) Heat pipe technology issues.** Merrigan, M.A. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 29p. (CONF-840113—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011384.

From Symposium on space nuclear power systems; Albuquerque, NM, USA (10 Jan 1984).

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Critical high temperature, high power applications in space nuclear power designs are near the current state of the art of heat pipe technology in terms of power density, operating temperature, and lifetime. Recent heat pipe development work at Los Alamos National Laboratory has involved performance testing of typical space reactor heat pipe designs to power levels in excess of 19 kW/cm² axially and 300 W/cm² radially at temperatures in the 1400 to 1500 K range. Operation at conditions in the 10 kW/cm² range has been sustained for periods of up to 1000 hours without evidence of performance degradation. The effective length for heat transport in these heat pipes was from 1.0 to 1.5 M. Materials used were molybdenum alloys with lithium employed as the heat pipe operating fluid. Shorter, somewhat lower power, molybdenum heat pipes have been life tested at Los Alamos for periods of greater than 25,000 hours at 1700 K with lithium and 20,000 hours at 1500°K with sodium. These life test demonstrations and the attendant performance limit investigations provide an experimental basis for heat pipe application in space reactor design and represent the current state-of-the-art of high temperature heat pipe technology.

25948 **(LA-UR—84-1381) Space reactor fuels performance and development issues.** Wewerka, E.M. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840804—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011414.

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

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Three compact reactor concepts are now under consideration by the US Space Nuclear Power Program (the SP-100 Program) as candidates for the first 100-kWe-class space reactor. Each of these reactor designs puts unique constraints and requirements

on the fuels system, and raises issues of fuel systems feasibility and performance. This paper presents a brief overview of the fuel requirements for the proposed space reactor designs, a delineation of the technical feasibility issues that each raises, and a description of the fuel systems development and testing program that has been established to address key technical issues.

25949 **(N—8411204) The space nuclear reactor program.** (Committee on Science and Technology (U.S. Congress. House), Washington, DC. Subcommittee on Energy Research and Production). 1983. 297p. (GPO—22-828). Subcommittee on Energy Research and Production, 98th Congress, Washington, DC.

Hearing before the Subcomm. on Energy Res. and Prod. and the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 98th Congr., 1st Sess., No. 25, 24 May 1983.

Space nuclear electric power research and development activities are reviewed as a part of the overall planning needed for a variety of high power civil, scientific, and military missions. The major elements include safety, mission analysis and requirements, system definition, and nuclear and aerospace technology development.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 25890, 25903, 25905, 25906, 25907, 25908, 25909, 25910, 25918, 25919, 25920, 26034

25950 **(NUREG—0040-Vol.8-No.1) Licensee contractor and vendor inspection status report. Quarterly report, January 1984-March 1984.** (Nuclear Regulatory Commission, Arlington, TX (USA). Region IV). Apr 1984. 308p. NTIS, PC A14/MF A01 - GPO*. Order Number DE84901206.

A fundamental premise of the Nuclear Regulatory Commission's (NRC) nuclear facility licensing and inspection program is that a licensee is responsible for the proper construction and safe operation of nuclear power plants. The total government-industry system for the inspection of nuclear facilities has been designed to provide for multiple levels of inspection and verification. Licensees, contractors, and vendors each participate in a quality verification process in accordance with requirements prescribed by, or consistent with, NRC rules and regulations. The NRC inspects to determine whethers its requirements are being met by a licensee and his contractors, while the great bulk of the inspection activity is performed by the industry within the framework of sequential ongoing quality verification programs. The White Book contains information normally used to establish a qualified suppliers list; however, the information contained in this document is not adequate nor is it intended to stand by itself as a basis for qualification of suppliers. Correspondence with contractors and vendors relative to the inspection data contained in the White Book is placed in the USNRC Public Document Room, located in Washington, DC.

25951 **(NUREG—0750-Vol.18-Index-1) Indexes to Nuclear Regulatory Commission issuances, July-September 1983.** (Nuclear Regulatory Commission, Washington, DC (USA)). 1983. 78p. NTIS, PC A05/MF A01 - GPO*. Order Number DE84901015.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as guide to the issuances.

25952 **(NUREG—0750-Vol.18-No.6) Nuclear Regulatory Commission issuances. Vol. 18, No. 6.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Dec 1983. 188p. NTIS, PC A09/MF A01 - GPO*. Order Number DE84901135.

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This report includes the issuances received during December 1983 from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

25953 **(NUREG—0936-Vol.3-No.1) NRC regulatory agenda. Quarterly report, January-March 1984.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). Apr 1984. 185p. NTIS, PC A09/MF A01 - GPO*. Order Number DE84901227.

The Regulatory Agenda is a quarterly compilation of all rules on which the NRC has proposed, or is considering action as well as those on which it has recently completed action, and all petitions for rulemaking which have been received and are pending disposition by the Commission.

25954 **(NUREG—0940-Vol.3-No.1) Enforcement actions: significant actions resolved. Quarterly progress report, January-March 1984. Vol. 3, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Apr 1984. 344p. NTIS, PC A15/MF A01 - GPO*. Order Number DE84901101.

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This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (January-March 1984) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions and the licensees' responses. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, in the interest of promoting public health and safety as well as common defense and security.

25955 **(DOE/RL/10153—T1-Vol.8-Pt.1) Shippingport Station Decommissioning Project decommissioning plan. Volume No. VIII, Part I.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). 1983. Contract AC06-80RL10153. 241p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84010912.

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Information is presented concerning the radiation work training program; final plant configuration document; engineering requirements for the preparation of detailed procedures; opportunities for cost-schedule reductions; potential risks and problems; cost-benefit criteria and procedure for keeping occupational radiation exposure as low as reasonably achievable; and engineering holds and assumptions.

2108 Economics

25956 **(LA-UR—84-64) Nuclear electric capacity expansion in Mexico: system effects of reactor size and cost.** Thayer, G.R.; Abbey, D.S.; Hardie, R.W.; Enriquez, R.P.; Uria, E.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840614—16). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006008.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Mexico's electrical generation capacity could more than double over the next ten years - from about 15 GWe currently to as much as 35 GWe in 1990. While new capacity additions will be predominantly oil-fired in the 1980's, nuclear power will become increasingly important in the 1990's. This study investigated the appropriate size of new, nuclear capacity additions by assessing the implications of installing different size reactors into Mexico's electrical grid. Included in the assessments of reactor sizes are estimates of electrical generation costs and comparisons of the effective load-carrying capability of a 10 GWe nuclear capacity expansion.

25957 **(DOE/RL/10153—T1-Vol.11-Pt.1) Shippingport Station Decommissioning Project decommissioning plan. Volume XI, Part I.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). Jul 1983. Contract AC06-80RL10153. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010903.

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This document is divided into the following parts: radioactive waste processing, salvage/scrap value estimate, and radionuclide inventory of primary systems. (DLC)

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 25983

25958 **(GA-A—17549) Status of HTGR steam cycle/cogeneration lead plant design.** Arbtin, E.; Caspersson, S.A.; Mulligan, J.B.; O'Neill, G.; Peinado, C.O.; Swart, F.E. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1984. Contract AT03-84SF11963. 13p. (CONF-840412—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011155.

From American power conference; Chicago, IL, USA (24 Apr 1984).

The conceptual design of a High Temperature Gas-Cooled Reactor (HTGR) Steam Cycle/Cogeneration (SC/C) Lead Plant has been completed and is described in this paper. It is a 2240-MW(t) variable cogeneration plant that generates up to 5 x 10^6 lb/h (630 kg/s) of high-temperature process steam and 230 MW(e) of cogenerated electricity or, alternatively, 820 MW(e) of electric power. The plant requirements and resulting design have been developed by use of functional analysis based on the Integrated Approach. Top-level goals for performance, availability, and economics have been specified, as well as goals for investment protection and public safety.

22 NUCLEAR REACTOR TECHNOLOGY

25959 **(CONF-840614—28) Automated reasoning applications to design analysis.** Stratton, R.C. (Argonne National Lab., Idaho Falls, ID (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006413.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Given the necessary relationships and definitions of design functions and components, validation of system incarnation (the physical product of design) and sneak function analysis can be achieved via automated reasoners. The relationships and definitions must define the design specification and incarnation functionally. For the design specification, the hierarchical functional representation is based on physics and engineering principles and bounded by design objectives and constraints. The relationships and definitions of the design incarnation are manifested as element functional definitions, state relationship to functions, functional relationship to direction, element connectivity, and functional hierarchical configuration.

2201 Theory And Calculation

25960 **(CONF-840614—31) Numerical treatment of pipe boundary conditions in two-phase flow.** Sha, W.C.; Gelbard, E.M. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006553.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Numerical treatment of two-phase flow in pipes seems to involve difficulties still not totally resolved. These difficulties are discussed for a simple two-fluid model, with no terms added to make characteristics real.

25961 **(CONF-840901—1) Midplane and off-midplane axial leakage simulation of heterogeneous subassemblies in EBR-II.** Grimm, K.N.; Meneghetti, D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009202.

From ANS topical meeting on physics and shielding; Chicago, IL, USA (17 Sep 1984).

Generally EBR-II XY geometry and one-dimensional (1D) cylindrical neutron flux calculations using transport theory analysis assume energy independent DB^2-type absorptions to simulate effects of axial leakages. This assumption, while generally resulting in satisfactory eigenvalues and high- and intermediate-energy flux spectra, gives large errors in the low-energy flux spectra where the flux levels are smaller. These midplane errors, and more importantly the off-midplane errors, can be reduced by using a more realistic leakage model: space and energy dependent leakage absorption cross sections. Analyses have been reported in which transport theory methods using row-wise azimuthally-homogeneous RZ-geometry boundary angular fluxes to calculate space and energy dependent leakage absorptions which were then used in subsequent 1D cylindrical simulations of RZ calculations. The present paper extends the study to include heterogeneous core loading configurations. This study contains modeling of heterogeneous XYZ loadings using heterogeneous XY geometry and space and energy dependent leakage absorptions. Because of the complexities arising from the three-dimensional analysis, the results presented here use diffusion theory. Although the actual negative leakage absorption values can be used in the CITATION diffusion theory code, it was found that the Σ/sub s/(1→g) method gave better results in the core region of these studies.

25962 **Uncertainty in the nuclear data used for reactor calculations. Sensitivity and uncertainty analysis of reactor performance parameters.** Peelle, R.W. (Engineering Physics Division Oak Ridge National Laboratory Union Carbide Corp. P.O. Box X Oak Ridge, TN 37830). *Advances in Nuclear Science and Technology;* **14**: 11-84(1982). Contract W-7405-ENG-26.

This chapter summarizes the techniques developed to estimate and codify nuclear data uncertainty. Focuses on the fifth version of the ENDF/B nuclear data file released in mid-1979. Discusses relevant aspects of a cross-section data base; mathematical properties of uncertainty matrices; the evaluation of nuclear data uncertainty; and existing nuclear data uncertainty files. Reports that distinct progress is being made toward development of comprehensive files of carefully evaluated cross-sections for nuclear system design. Notes that while contemporary evaluations of a cross-section should in principle be equal, they have in practice been unequal because of the variety of techniques used and the different estimates of the information content of each experiment. Concludes that if full value is to be gained from improved files representing differential data, inclusion of integral information must be correctly structured and documented with care so that each piece of information is given proper weight.

25963 **Calculational methodology and associated uncertainties: Sensitivity and uncertainty analysis of reactor performance parameters.** Kujawski, E.; Weisbin, C.R. (NUTECH 6835 Via Del Oro San Jose, CA 95119). *Advances in Nuclear Science and Technology;* **14**: 85-157(1982). Contract W-7405-ENG-26.

This chapter considers the calculational methodology and associated uncertainties both for the design of large LMFBR's and the analysis of critical assemblies (fast critical experiments) as performed by several groups within the US. Discusses cross-section processing; calculational methodology for the design problem; core physics computations; design-oriented approximations; benchmark analyses; and determination of calculational corrections and associated uncertainties for a critical assembly. Presents a detailed analysis of the sources of calculational uncertainties for the critical assembly ZPR-6/7 to illustrate the quantitative assessment of calculational correction factors and uncertainties. Examines calculational uncertainties that arise from many different sources including intrinsic limitations of computational methods; design-oriented approximations related to reactor modeling; computational capability and code availability; economic limitations; and the skill of the reactor analyst. Emphasizes that the actual design uncertainties in most of the parameters, with the possible exception of burnup, are likely to be less than might be indicated by the results presented in this chapter because reactor designers routinely apply bias factors (usually derived from critical experiments) to their calculated results.

25964 **Integral experiment information for fast reactors: Sensitivity and uncertainty analysis of reactor performance parameters.** Collins, P.J. (Argonne National Laboratory-West P.O. Box 2528 Idaho Falls, ID 83401). *Advances in Nuclear Science and Technology;* **14**: 159-192(1982). Contract W-7405-ENG-26.

This chapter offers a detailed analysis of uncertainties in experimental parameters for the ZPR benchmark cores. Discusses the critical facilities and measurements; the need for well documented data; the relevance of data for reactor design; uses of integral data; benchmark data; mockup cores; accuracy of experimental data; critical mass; reaction rate ratios; covariance matrices; selection of reliable integral data; cavity measurements; and the SCHERZO 556 core. Points out that substantial revisions of data in the CSEWG benchmark book have resulted from a reevaluation of analytical corrections using modern methods and codes. Concludes that the integral data presently being utilized represent a very limited base, which will be enlarged considerably before application to a wider range of power reactor parameters.

25965 **Sensitivity functions for uncertainty analysis: Sensitivity and uncertainty analysis of reactor performance parameters.** Greenspan, E. (Nuclear Research Center P.O. Box 9001 Beer-Sheva 82190). *Advances in Nuclear Science and Technology;* **14**: 193-246(1982). Contract W-7405-ENG-26.

This chapter presents the mathematical basis for sensitivity functions, discusses their physical meaning and information they contain, and clarifies a number of issues concerning their application, including the definition of group sensitivities, the selection of sensitivity functions to be included in the analysis, and limitations of sensitivity theory. Examines the theoretical foundation; criticality reset sensitivities; group sensitivities and uncertainties; selection of sensitivities included in the analysis; and other uses and limitations of sensitivity functions. Gives the theoretical formulation of sensitivity functions pertaining to "as-built" designs for performance parameters of the form of ratios of linear flux functionals (such as reaction-rate ratios), linear adjoint functionals, bilinear functions (such as reactivity worth ratios), and for reactor reactivity. Offers a consistent procedure for reducing energy-dependent or fine-group sensitivities and uncertainties to broad group sensitivities and uncertainties. Provides illustrations of sensitivity functions as well as references to available compilations of such functions and of total sensitivities. Indicates limitations of sensitivity theory originating from the fact that this theory is based on a first-order perturbation theory.

25966 **Combination for differential and integral data: Sensitivity and uncertainty analysis of reactor performance parameters.** Marable, J.H.; de Saussure, G.; Weisbin, C.R. (Engineering Physics Division Oak Ridge National Laboratory Union Carbide Corp. P.O. Box X Oak Ridge, TN 37830). *Advances in Nuclear Science and Technology;* **14**: 247-312(1982). Contract W-7405-ENG-26.

This chapter attempts to show how the various types of data presented and discussed in previous chapters can be combined and applied to the calculation of performance parameters of a reactor design model. Discusses derivation of least-squares adjustment; input data to the adjustment; the results of adjustment; and application to an LMFBR. Demonstrates that the least-squares formulae represent a logical, well-founded method for combining the results of integral and differential experiments. Includes calculational bias factors and their uncertainties. Concludes that the adjustment technique is a valuable tool, and that significant progress has been made with respect to its development and its applications. Recommends further work on the evaluation of covariance files, especially for calculational biases, and the inclusion of specific shielding factors as variables to be adjusted. The appendix features a calculation whose goal is to find the form of the projection operator which projects perpendicular to the calculational manifold.

25967 **New developments in sensitivity theory: Sensitivity and uncertainty analysis of reactor performance parameters.** Greenspan, E. (Nuclear Research Center P.O. Box 9001 Beer-Sheva 82190). *Advances in Nuclear Science and Technology;* **14**: 313-361(1982). Contract W-7405-ENG-26.

This chapter examines additional developments necessary for the uncertainty analysis methodology to be applicable for the wide range of problems encountered in the design and analysis of nuclear reactors. Discusses improvements and refinements of the present machinery, and extensions of the sensitivity and uncertainty analysis methodologies to new domains. Attempts to lay the foundations of the sensitivity theory basis for several improvements and extensions. Recommends that the sensitivity and uncertainty methodologies be extended to include the capability for multiple-constraint analysis. Predicts that time-dependent perturbation theory for the coupled neutron, nuclide, temperature and coolant flow fields will find an increasing number of applications in uncertainty analysis as well as in reactor design and optimization. Presents a second-order sensitivity theory (SOST) which may provide the desirable accuracies even for the special cases which first-order sensitivity theory (FOST) cannot handle.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 26331

25968 **(BNL-NUREG—34243) Evaluation of selected approximations used in pressure vessel fluence calculations.** Todosow, M.; Carew, J.F.; Kohut, P. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-840614—41). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007374.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

In response to concerns over the issue of Pressurized Thermal Shock (PTS), Brookhaven National Laboratory (BNL), under the direction of the USNRC, has developed and benchmarked a methodology for calculating pressure vessel (PV) (>1-MeV) damage fluence. The methodology is based on the DOT-3.5 discrete ordinates transport code and has been shown to yield fluence results in good agreement with measurements and results from other calculations. This paper describes the basic methodology employed in BNL PV fluence calculations, and the results of a number of studies performed to assess the impact of various special effects on the calculated (>1-MeV) PV fluence.

25969 **(BNL-NUREG—34546) Parametric studies on the load-deflection characteristics of hydraulic snubbers.** Subudhi, M.; Curreri, J., Bezler, P.; Hartzman, M. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-840647—13). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010281.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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Hydraulic snubbers are extensively used in the nuclear power industry for supporting high energy piping systems subjected to dynamic loadings. These devices allow the piping system to displace freely under slowly applied loads, but lock up under sudden excitations. This paper presents the governing differential equations describing the hydro-mechanical mechanisms of a typical snubber. A finite difference computer code, SNUBER, was developed to solve these equations. Using the code, the load deflection characteristics of the unit were developed for a range of parameters of interest. The parameters included leakage orifice area, initial piston location, eyebolt clearance and reservoir pressures. The results include the load deflection characteristics for various combinations of the controlling parameters and some chamber pressure time history profiles. It is intended that the nonlinear characteristic of the snubbers be incorporated into a structural dynamic analysis program to allow prediction of the overall response of nuclear piping supported by these devices and subjected to a variety of loadings.

25970 **(CONF-840614—6) Long term creep calculation of reactor containment.** Pfeiffer, P.A.; Marchertas, A.H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005265.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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The creep analysis which lends itself to high temperature and humidity changes is the rate-type approach. This approach consists of reducing the history dependence of creep to a set of first-order differential equations. The structure of the rate-type creep law can be visualized by the spring-dash-pot system. Two rheological models, the Kelvin and Maxwell, have been shown to be quite successful in modeling concrete creep. From these two, the Maxwell chain model offers certain theoretical advantages over the Kelvin chain model and is, hence, employed in our analytical simulations. The Maxwell chain creep model has been integrated into the TEMP-STRESS code system from the revised CREEP80 model. Thus, the new creep computational capability, among others, now involves simultaneous thermal conduction calculations. The effect of creep of a large prestressed reactor containment vessel is presented to illustrate this calculational capability.

25971 **(NUREG/CR—3334-Vol.3) Heavy-Section Steel Technology Program. Quarterly progress report for July-September 1983. Vol. 3.** Pugh, C.E. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract W-7405-ENG-26. 132p. (ORNL/TM—8787-Vol.3). NTIS, PC A07/MF A01 - GPO; GPO Dep. Order Number DE84007577.

The program comprises studies related to all areas of the technology of materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The investigation focuses on the behavior and structural integrity of steel pressure vessels containing cracklike flaws. Current work is organized into seven tasks: (1) program administration and procurement, (2) fracture-mechanics analyses and investigations, (3) investigations of irradiated materials, (4) thermal-shock investigations, (5) pressure vessel investigations, (6) stainless steel cladding investigations, and (7) environmentally assisted crack-growth studies. Further analyses were performed to determine material parameters and pressure-temperature transients compatible with potential pressurized-thermal-shock experiments. Subcontractors continued studies on crack arrest, crack reinitiation, fracture transition, and environmentally assisted crack growth. Tensile tests were performed for irradiated specimens in the Third and Fourth Irradiation Series. Irradiation of the first two capsules containing Charpy and tensile specimens of one-wire stainless steel cladding was completed. Posttest analyses of thermal-shock experiment TSE-7 were conducted, and further properties data for the TSE-7 test material were determined. Preparations for the first pressurized-thermal-shock experiment PTSE-1 continued. At the test facility, the data acquisition system was integrated, a revised pressurization system was finalized, and vessel alignment fixtures were fabricated. The vessel being used in the shakedown test was instrumented and inserted into the facility. Flow and pressurization tests were performed at ambient temperature. Preparations are under way for tests of the heating system.

25972 **(NUREG/CR—3625) Review and discussion of the development of synthetic aperture focusing technique for ultrasonic testing (SAFT-UT).** Busse, L.J.; Collins, H.D.; Doctor, S.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 114p. (PNL—4957). NTIS, PC A06/MF A01; 1 - GPO $5.00; GPO Dep. Order Number DE84009337.

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The development and capabilities of synthetic aperture focusing techniques for ultrasonic testing (SAFT-UT) are presented. The purpose of SAFT-UT is to produce high-resolution images of the interior of opaque objects. The goal of this work is to develop and implement methods which can be used to detect and to quantify the extent of defects and cracks in critical components of nuclear reactors (pressure vessels, primary piping systems, and nozzles). This report places particular emphasis upon the practical experimental results that have been obtained using SAFT-UT as well as the theoretical background that underlies synthetic aperture focusing. A discussion regarding high-speed and real-time implementations of two- and three-dimensional synthetic aperture focusing is also presented.

25973 **(NUREG/CR—3687) Loose-part monitoring programs and recent operational experience in selected US and western European commercial nuclear power stations.** Kryter, R.C. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 57p. (ORNL/TM—9107). NTIS, PC A04/MF A01 - GPO; GPO Dep. Order Number DE84010563.

Technical personnel at thirteen nuclear power stations (ten in the US and three in Western Europe) were interviewed during the summer of 1983 to ascertain their collective experience with acoustic-based loose-part monitoring systems (LPMSs). Subjects receiving special attention were the number and location of sensors (accelerometers) required to reliably detect and locate loose parts in both pressurized- and boiling-water reactors; detection sensitivity to loose objects in both primary and secondary coolant loops; false alarm experience; calibration procedures; day-to-day monitoring system operation; premature failure of in-containment components of the LPMS caused by hostile environments; and overall success to date in detecting the presence of potentially damaging loose parts and in assessing their operational and safety implications. The individual utilities' responses to questions addressing these and other issues are provided, along with the author's summary and interpretation of what the information gathered means in a collective sense, that is, a viewpoint of the present state of application of loose-part monitoring technology in this selected set of commercial nuclear plants. It is concluded that the technology of loose-part detection and assessment is moving slowly toward increased acceptance by the utility industry but, at the same time, the full potential benefits of loose-part monitoring systems are not presently being realized and, furthermore, probably will not be unless actions are taken in four recommended areas.

25974 **Controlled biaxial strain-rate testing of 20% cold-worked type 316 stainless steel fast reactor cladding.** Cannon, N.S.; Wire, G.L. (Westinghouse Hanford Company, P.O. Box 1970, W/A-65 Richland, Washington 99352). *Nuclear Technology;* **63**: No. 1, 50-62(Oct 1983). Contract AC06-76FF02170.

A new simulated transient test capability is introduced that allows controlled biaxial strain-rate (CBSR) tests on fast reactor cladding to be performed at constant test temperatures ranging from 425 to 650°C and constant diametral strain rates between 10^{-5} and 10^{-3}/s. The CBSR test results from both irradiated and unirradiated 20% cold-worked Type 316 stainless steel are reported. A mathematical expression describing CBSR strengths was developed from tensile data. The CBSR ductility was generally found to be reduced from corresponding tensile results by roughly an order of magnitude. For unirradiated cladding, diametral failure strain was relatively strain-rate independent below 650°C, and at 650°C, failure strains increased with decreasing strain rate. Following fast reactor irradiation at 370 to 680°C cladding, diametral failure strains increased with increasing irradiation temperature. The sensitive diameter measurement apparatus allowed strain determinations showing the importance of anelastic effects at low plastic strains.

25975 **Radiation effects in metals and alloys.** Mansur, L.K. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 68-75(Fal 1983).

Fission power plants and future fusion devices can be reliable sources of electric power if they have components that last a long time before being replaced. Neutrons from fission and fusion power plants can lead to profound changes in metals and alloys. The Oak Ridge National Laboratory's research program on understanding how radiation alters the properties of these materials is discussed. The ultimate goal of this program is to determine the mechanisms underlying these changes and to select and design alloys that resist radiation damage.

25976 **Eddy-current inspection of energy-system components.** *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 76-80(Fal 1983).

Reliability is crucial in nuclear power plants because equipment failures can shut down the plant and force a utility to replace its electricity with higher priced power from other sources. Shut-

ting down a 1000-MW plant costs about $50,000/hr for replacement power at normal consumer rates. Higher performance power plants are being achieved by using improved materials and components. In the ORNL program aimed at improving eddy current devices for in-service inspection for steam generator tubing, a multifrequency-multiprobe device has been developed that can detect several different types of flaws in a single pass through a tube. ORNL's research effort in developing eddy current inspection techniques is discussed.

25977 **Materials technologies for advanced nuclear energy concepts.** DiStefano, J.; Harms, B. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 93-95(Fal 1983).

High-performance, advanced nuclear power plant concepts have emerged with major emphasis on lower capital costs, inherent safety, and increased reliability. The materials problems posed by these concepts are discussed and how the scientists and technologists at ORNL plan to solve them is described.

25978 **Creep-fatigue effects in structural materials used in advanced nuclear power generating systems.** Brinkman, C.R. (Metals and Ceramics Div., ORNL, Oak Ridge, TN 37830). pp 241-264 of Fatigue. Environment and temperature effects. Burke, J.J.; Weiss, V. New York, NY; Plenum Publishing Corp. (1983). (CONF-800741—). Contract W-7405-ENG-26.

From 27. sagamore army materials research conference; Bolton Landing, NY, USA (14 Jul 1980).

The authors review various aspects of time-dependent fatigue behavior of a number of structural alloys in use or planned for use in advanced nuclear power generating systems. Materials included are types 304 and 316 stainless steel, Fe-2 1/4 Cr-1 Mo steel, and alloy 800H. Examples of environmental effects, including both chemical and physical interaction, are presented for a number of environments. The environments discussed are high-purity liquid sodium, high vacuum, air, impure helium, and irradiation damage, including internal helium bubble generation.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 25394, 26422

25979 **(N—73-31614) Irradiation of three T-111 clad uranium nitride fuel pins for 8070 hours at 990°C (1815°F).** Slaby, J.G.; Siegel, B.L.; Gedeon, L.; Galbo, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1973. 42p. (NASA-TM-X—2878). NTIS, PC A03.

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The design and successful operation of three tantalum alloy (Ta-8W-2Hf) clad uranium mononitride (UN) fuel pins irradiated for 8070 h at 990°C (1815°F) is described. Two pin diameters having measured burnups of 0.47 and 0.90 uranium atom percent were tested. No clad failures or swelling was detected; however, postirradiation clad samples tested failed with 1 percent strain. The fuel density decrease was 2 percent, and the fission gas release was less than 0.05 percent. Isotropic fuel swelling, which averaged about 0.5 percent, was less than fuel pin assembly clearances. Thus the clad was not strained. Thermocouples with a modified hot zone operated at average temperatures to 1100°C (2012°F) without failure. Factors that influence the ability to maintain uniform clad temperature as well as the results of the heat transfer calculations are discussed.

25980 **Detachable connection for a nuclear reactor fuel assembly.** Christiansen, D.W.; Karnesky, R.A. (to Dept. of Energy). US Patent Application 6-527,547. 29 Aug 1983. 17p. Contract AC06-76FF02170.

A locking connection for releasably attaching a handling socket to the duct tube of a fuel assembly for a nuclear reactor. The connection comprises a load pad housing mechanically attached to the duct tube and a handling socket threadably secured within the housing. A retaining ring is interposed between the housing and the handling socket and is formed with a projection and depression engagable within a cavity and groove of the housing and handling socket, respectively, to form a detachable interlocked connection assembly.

2204 Control Systems

25981 (CONF-830528—Vol.2, pp 1519-1526) **Experience in BWR control rod shipping.** LaBar, M.P.; Webster, L.J. (GA Technologies Inc., San Diego, CA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A system for shipment of irradiated BWR control rods to burial sites for disposal has been developed and successfully used. The system entails the use of the Model FSV-1 shipping cask which permits up to four full-length rods to be shipped at one time. Preparation of the control rods for shipping includes the removal of roller balls and axles from the upper corners of the control rod blades. A specially designed shear machine has been developed and performs very effectively for the roller ball/axle removal. To date approximately ten shipments have been successfully made and control rods have been sheared for approximately twenty more shipments. It is estimated that by the end of the current year at least forty shipments will have been completed. These forty shipments will have been made from a total of five different BWR power plants.

25982 **(CONF-831015—46) Position-sensitive fission counter for in-core flux profile monitoring.** Kopp, M.K.; Valentine, K.H.; Guerrant, G.C.; Harter, J.A. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84002055.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A prototype model of a position-sensitive fission counter (PSFC) was developed for power-range flux profile monitoring in light-water reactor cores. The flux profile is measured by delay-line position encoding and time interval decoding of individual fission pulses from 11 small fission counters incorporated along a coaxial transmission line. Significant improvements over currently used flux profile monitors are the 33-cm spatial resolution of the 3.5-m-long PSFC and the requirement for only one cable penetration into the reactor pressure vessel.

25983 **(GA-A—17509) HTGR steam cycle/cogeneration control system structure and operator interface.** Giegler, D.P.; Melcher, F.R.; Zgliczynski, J.B. (GA Technologies, Inc., San Diego, CA (USA); United Engineers and Constructors, Inc., Philadelphia, PA (USA)). 1984. Contract AT03-84SF11963. 11p. (CONF-840412—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011156.

From American power conference; Chicago, IL, USA (24 Apr 1984).

The High Temperature Gas-Cooled Reactor Steam Cycle/Cogeneration (HTGR-SC/C) plant is uniquely designed to supply up to five million pounds per hour of process steam at 650 psig (4.5 MPa) and 100°F (56°C) of superheat and to provide up to 820 MW of net electricity to the utility grid. A state-of-the-art distributed microprocessor control system, used to vary the plant output to meet demands for both process steam and electric generation, is the first system of this type to be designed for use in a nuclear power plant. This structure allows local direct digital control as well as centralized supervisory control, resulting in a modern control room based on computer-driven displays and optimized man-machine interfaces.

25984 **(HEDL-SA—3020-FP) Automated rule-base control for nuclear power plants.** Colley, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76FF02170. 10p. (CONF-840652—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004828.

From American Control conference; San Diego, CA, USA (6 Jun 1984).

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An effort is underway to optimize the roles of man and machine in the control of liquid-metal-cooled fast breeder reactors. The work reported here describes: (1) a methodology for the decomposition of a process into a hierarchical structure; (2) an explicit methodology, Sequencing Established States, to limit the state space search for process control; and (3) the Procedure Prompting System which demonstrates the use of the above methodologies for automatically generating instructions to provide guidance to an operator for both normal and off-normal plant conditions.

25985 **(NUREG/CR—3303) Use of neutron noise for diagnosis of in-vessel anomalies in light-water reactors.** Fry, D.N.; March-Leuba, J.; Sweeney, F.J. (Oak Ridge National Lab., TN (USA)). Jan 1984. Contract AC05-84OR21400. 98p. (ORNL/TM—8774). NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84010431.

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The value of neutron noise analysis for diagnosis of in-vessel anomalies in light-water reactors (LWRs) was assessed by: (1) analyzing ex-core neutron noise from seven pressurized-water reactors (PWRs) to determine the degree of similarity in the noise signatures and the sources of ex-core neutron noise; (2) measuring changes in ex-core neutron noise over an entire fuel cycle at a commercial PWR; (3) applying PWR neutron noise analysis to diagnose a loose core barrel, to infer in-core coolant velocity, and to infer fuel assembly motion; and (4) applying BWR neutron noise analysis to diagnose in-core instrument tube vibrations and bypass coolant boiling, to infer in-core two-phase flow velocity and void fraction, and to infer stability associated with reactivity feedback. This report summarizes these assessments and provides guidance for the acquisition and analysis of neutron noise in LWRs.

25986 **(PNL-SA—11751) Critical and sub-critical experiments on lattices of UO_2/PuO_2 fuel in water poisoned with gadolinium nitrate solution.** Keay, R.T.; Bierman, S.R.; Broome, P.E.; Clemson, P.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1983. Contract AC06-76RL01830. 33p. (CONF-8309105—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011169.

From International seminar on criticality experiments and data; Dijon, France (20 Sep 1983).

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In support of its nuclear fuel cycle activities, British Nuclear Fuels Limited (BNFL) has commissioned the construction of a series of critical and sub-critical experimental cores consisting of heterogeneous lattices of fuel pins arranged in water poisoned with gadolinium nitrate solution. The principal objectives of the program were to assist in validating a particular calculation route being developed for BNFL design and safety assessments, and to derive data for the use of gadolinium as a neutron poison in nuclear chemical plant operations. The experiments used aluminium clad oxide fuel pins covering three enrichments; 4.31 w/o U235, 2.35 w/o U235 and a PuO_2/ natural UO_2 mixture. The fuel pins were arranged on a triangular pitched lattice, flooded and fully reflected axially and radially with water to which gadolinium nitrate may be added.

25987 **Multi-function magnetic jack control drive mechanism.** Bollinger, L.R.; Crawford, D.C. (to Dept. of Energy). US Patent Application 6-539,370. 6 Oct 1983. 16p. Contract AC12-76SN00052.

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A multi-function magnetic jack control drive mechanism for controlling a nuclear reactor is provided. The mechanism includes an elongate pressure housing in which a plurality of closely spaced drive rods are located. Each drive rod is connected to a rod which is insertable in the reactor core. An electromechanical stationary latch device is provided which is actuatable to hold each drive rod stationary with respect to the pressure housing. An electromechanical movable latch device is also provided for each one of the drive rods. Each movable latch device is provided with a base and is actuatable to hold a respective drive rod stationary with respect to the base. An electromechanical lift device is further provided for each base which is actuatable for moving a respective base longitudinally along the pressure housing. In this manner, one or more drive rods can be moved in the pressure housing by sequentially and repetitively operating the electromechanical devices. Preferably, each latch device includes a pair of opposed latches which grip teeth located on the respective drive rod. Two, three, or four drive rods can be located symmetrically about the longitudinal axis of the pressure housing.

25988 **Nuclear reactor safety device.** Hutter, E. (to Dept. of Energy). US Patent Application 6-523,207. 15 Aug 1983. 21p. Contract W-31-109-ENG-38.

A safety device is described for use in a nuclear reactor for axially repositioning a control rod with respect to the reactor core in the event of a thermal excursion. It comprises a laminated strip helically configured to form a tube, said tube being in operative relation to said control rod. The laminated strip is formed of at least two materials having different thermal coefficients of expansion, and is helically configured such that the material forming the outer lamina of the tube has a greater thermal coefficient of expansion than the material forming the inner lamina of said tube. In the event of a thermal excursion the laminated strip will tend to curl inwardly so that said tube will increase in length, whereby as said tube increases in length it exerts a force on said control rod to axially reposition said control rod with respect to said core.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 25915, 27033, 27082

25989 **(DPST—82-617) Processes influencing cooling of reactor effluents.** Magoulas, V.E.; Murphy, C.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 7 Jun 1982. Contract AC09-76SR00001. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011516.

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Discharge of heated reactor cooling water from SRP reactors to the Savannah River is through sections of stream channels into the Savannah River Swamp and from the swamp into the river. Significant cooling of the reactor effluents takes place in both the streams and swamp. The majority of the cooling is through processes taking place at the surface of the water. The major means of heat dissipation are convective transfer of heat to the air, latent heat transfer through evaporation and radiative transfer of infrared radiation. A model was developed which incorporates the effects of these processes on stream and swamp cooling of reactor effluents. The model was used to simulate the effect of modifications in the stream environment on the temperature of water flowing into the river. Environmental effects simulated were the effect of changing radiant heat load, the effect of changes in tree canopy density in the swamp, the effect of total removal of trees from the swamp, and the effect of diverting the heated water from L reactor from Steel Creek to Pen Branch. 6 references, 7 figures.

25990 **(NUREG/CR—3756) Seismic hazard characterization of the eastern United States: methodology and interim results for ten sites.** Bernreuter, D.L.; Savy, J.B.; Mensing, R.W.; Chung, D.H. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 542p. (UCRL—53527). NTIS, PC A23/MF A01; 1 - GPO $10.00; GPO Dep. Order Number DE84011311.

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The objectives of the (SHC) are: (1) to develop a seismic hazard characterization methodology for the region east of the Rocky Mountains; and (2) the application of the methodology to ten sites to assist the NRC staff in their assessment of the implications in the clarification of the US Geological Survey (USGS) position on the Charleston earthquake. The fundamental characteristic of the methodology used in SHC consists in using expert opinions for all the input data. The most important improvement over the methodology used in the SEP leads to an estimate of the distribution of the hazard rather than just point estimates. An important aspect of eliciting expert opinion consists in holding feedback meetings in order to fine tune the methodology and the input data. At this point, the feedback process has not been completed. Our meth-

odology and preliminary input from the expert panels is presented. Estimates of the hazard (PGA and spectral velocity) at ten representative sites are discussed including a sensitivity analysis and a comparison with the SEP results at four sites. 47 references, 196 figures, 25 tables.

25991 **An on-line radio-nuclide liquid effluent monitor with a reduced contamination rate.** Malm, H.L.; Mallory, P.G.; Walker, R.A.P. (Aptec Engineering Ltd., 4251 Steeles Ave. West, Downsview, Ontario M3N1V7). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 668-671(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A problem with on-line monitoring of radionuclides in liquid effluent is the build-up of contamination and background on all wetted surfaces. A combination of beta monitoring, a dual phosphor scintillator, and sample geometry was used to reduce the rate of increase of background compared to other types of monitors. Performance in a nuclear station with an effluent (before dilution) of 1.7MBq/m^3 (45uCi/m^3) Cs^{137} equivalent showed a contamination rate of 800 times less than a monitor without the above features.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 25415, 26002, 26004, 26023, 26170

25992 **(DOE/ER/03409—1) Pennsylvania State University, Breazeale Nuclear Reactor twenty-eighth annual progress report, July 1, 1982-June 30, 1983.** Totenbier, R.E. (ed.). (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Jul 1983. Contract AC02-76ER03409. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011509.

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This report provides a summary of the operation and uses of the TRIGA facility for the past year. The cobalt-60 facility and its uses are also discussed. (DLC)

25993 **(HEDL-SA—2957-FP) FFTF operating experience, 1982-1984.** Waldo, J.B.; Franz, G.R.; Loika, E.F.; Krupar, J.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1984. Contract AC06-76FF02170. 10p. (CONF-840411—19). NTIS, PC A02; 3; GPO Dep. Order Number DE84011117.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

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The Fast Flux Test Facility (FFTF) is a 400 Mwt sodium-cooled fast reactor operating at the Hanford Engineering Development Laboratory, Richland, Washington, to conduct fuels and materials testing in support of the US Liquid Metal Fast Breeder Reactor (LMFBR) program. Startup and initial power testing included a comprehensive series of nonnuclear and nuclear tests to verify the thermal, hydraulic, and neutronic characteristics of the plant. A specially designed series of natural circulation tests were then performed to demonstrate the inherent safety features of the plant. Early in 1982, the FFTF began its first 100-day irradiation cycle. Since that time the plant has operated very well, achieving a cycle capacity factor of 94% in the most recent irradiation cycle. Seventy-five specific test assemblies and 25,000 individual fuel pins have been irradiated, some in excess of 80 MWd/Kg.

25994 **(SURRC—71-83) Report on session 1981-1982.** Wilson, H.W. (Scottish Universities Research and Reactor Centre, Glasgow (UK)). 1983. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700969.

The effects of nuclear radiation on the electrical properties of insulating materials at liquid helium temperatures in the reactor core is one new area of research; this is important in the fusion field. Research on radionuclides in the environment has also been started. Further steps towards a facility to measure sulphur isotopic ratios in geochemistry have been made. Reports on the reactor related activities (radiochemistry, health physics and nuclear medicine, computing, physics and engineering), isotope geology (solid source group, potassium argon laboratory, stable isotope geochemistry laboratory and uranium series geochronology), the NERC Radiocarbon laboratory, and the teaching aspects are given.

2207 Plutonium And Isotope Production Reactors

25995 **(UNI-SA—120) RETRAN analysis of the Hanford N-reactor for a loss of feedwater.** Schmitt, B.E. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 28 Mar 1984. Contract AC06-76RL01857. 23p. (CONF-8404133—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84009869.

From 3. international RETRAN meeting; Las Vegas, NV, USA (9 Apr 1984).

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RETRAN-02 is being used to analyze operational transients at the Hanford N Reactor. Included in the scope of the transients was a loss of feedwater from two 430-MWe turbines to the secondary cooling system. This paper presents the analysis of this transient, with emphasis on the secondary loop responses. An actual loss of feedwater from one of the two turbines occurred prior to this analysis. Plant data obtained from this transient were used to assist in validation of the RETRAN computer model. A comparison of these actual data with the RETRAN-02 predictions is also presented.

25996 **(UNI-TR—9) Phenomenology and modeling of particulate corrosion product behavior in Hanford N Reactor primary coolant.** Bechtold, D.B. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 31 Dec 1983. Contract AC06-76RL01857. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011833.

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The levels and composition of filterable corrosion products in the Hanford N Reactor Primary Loop are measurable by filtration. The suspended crud level has ranged from 0.0005 ppM to 6.482 ppM with a median 0.050 ppM. The composition approximates magnetite. The particle size distribution has been found in 31 cases to be uniformly a log normal distribution with a count median ranging from 1.10 to 2.31 microns with a median of 1.81 microns, and the geometric standard deviation ranging from 1.60 to 2.34 with a median of 1.84. An auto-correcting inline turbidimeter was found to respond to linearly to suspended crud levels over a range 0.05 to at least 6.5 ppM by direct comparison with filter sample weights. Cause of crud bursts in the primary loop were found to be power decreases. The crud transients associated with a reactor power drop, several reactor shutdowns, and several reactor startups could be modeled consistently with each other using a simple stirred-tank, first order exchange model of particulate between makeup, coolant, letdown, and loosely adherent crud on pipe walls. Over 3/10 of the average steady running particulate crud level could be accounted for by magnetically filterable particulate in the makeup feed. A simulation model of particulate transport has been coded in FORTRAN.

25997 **Fuel assembly for the production of tritium in light water reactors.** Cawley, W.E.; Trapp, T.J. (to Dept. of Energy). US Patent Application 6-503,129. 10 Jun 1983. 8p. Contract AC06-76RL01857.

A nuclear fuel assembly is described for producing tritium in a light water moderated reactor. The assembly consists of two intermeshing arrays of subassemblies. The first subassemblies comprise concentric annular elements of an outer containment tube, an annular target element, an annular fuel element, and an inner neutron spectrums shifting rod. The second subassemblies comprise an outer containment tube and an inner rod of either fuel, target, or neutron spectrum shifting neutral.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 26011

25998 **Space nuclear reactor program. Hearing before the Subcommittee on Energy Research and Production and the Subcommittee on Space Science and Applications, Ninety-Eighth Congress, First Session, May 24, 1983.** Washington, DC; Government Printing Office (1983). 294p.

Eight witnesses from space and nuclear reactor laboratories and industries testified on the potential for on-board electric power generation by nuclear reactors in both military and civilian space vehicles. The hearing included a status report on a triagency agreement involving DOE, the National Aeronautics and Space Administration, and the Defense Advanced Research Projects Agency (DARPA). Supplemental questions and answers submitted for the record by six space and nuclear industries and additional information submitted for the record appear in the appendix.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 25555, 25556, 25565, 25882, 25890, 25990, 26610

25999 **(AAEC/E—566) NAIADQ, a computer program for calculating reactivity transients in low power experimental water reactors.** Dalton, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1983. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700930.

The computer code NAIADQ is designed to simulate the course and consequences of non-destructive reactivity accidents in low-power, experimental, water-cooled reactor cores fuelled with metal plate elements. It is a coupled neutron kinetics-hydrodynamics-heat transfer code which uses point kinetics and one-dimensional thermohydraulic equations. Nucleate boiling, which occurs at the fuel surface during transients, is modelled by the growth of a superheated layer of water in which vapour is generated at a non-equilibrium rate. It is assumed that this vapour is formed at its saturation temperature and that it mixes homogeneously with the water in this layer. The code is written in FORTRAN IV and has been programmed to run as a catalogued procedure on an IBM operating system such as MVT or MVS, with facility for the inclusion of user routines.

26000 **(AAEC/E—568) ZAPP - a computer program for simulation of reactor power transients.** Clancy, B.E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1983. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700931.

This report describes a computer program which simulates power excursions in experimental fission reactors. A point reactor kinetics model is coupled with a one-dimensional heat conduction capability which allows the code to determine reactivity feedback produced as a result of density and temperature variations within the reactor. External reactivity step insertions and ramps may be included in the calculation. A simple treatment of coolant flow is available. Test cases are provided, including one which simulates a run from the SPERT series of experiments.

26001 **(BMI—1983-002) Safety analysis of a stratified reactor foundation subject to core meltdown.** Laermann, K.H.; Berhalter, D.; Wieching, G. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Sep 1983. 65p. (In German). Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, (Germany, F.R.).

Comprehensive calculations were made to examine a foundation plate under static load with non-linear material behaviour. In particular, deformation and crack behaviour of the plate were observed. The calculations hereunder, made to calculate the time of rupture of the plate with the foundation exposed to high temperatures, with and without cavity formation, prove that high temperatures are not as relevant as the melt-down of the layers of armour on top of the middle of the plate. The consequences of this survey are: to protect the top armour of the plate centre and not to use it as support for any structural components. This free space could then be used to instal said multi-layer plate.

26002 **(BNL-NUREG—34141) Minet validation study using EBR-II transient data.** Van Tuyle, G.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-840614—43). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007379.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The MINET code, developed to simulate large and complex thermal-hydraulic systems, such as balance of plant, was used to simulate an EBR-II test transient. MINET calculations agreed well with measured parameters, confirming the validity of the basic MINET methodology and key component models.

26003 **(BNL-NUREG—34212) Estimation of pre-existing LWR containment leakage areas for severe accident conditions.** Agrawal, A.K.; Hall, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 5p. (CONF-840614—35). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006751.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

We have reported our findings of the pre-existing leakage areas from the subatmospheric, atmospheric (dry and ice-condenser) PWRs and the BWRs. The subatmospheric plants employ rather tight containment and hence the pre-existing leakage areas are generally quite small (perhaps inconsequential in the progression of severe accidents). The pre-existing leakage areas for other plants are considerably larger and can have a significant impact on the progression of severe accidents. Finally, we note that the sealant degradation must be considered, since most of the seal materials may not withstand the temperatures, pressures, and the duration of their exposure, typical of severe accidents.

26004 **(BNL-NUREG—34245) Long term post-test simulation of the FFTF natural circulation tests using SSC.** Horak, W.C.; Kennett, R.J.; Guppy, J.G. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-840614—36). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006759.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

As part of the validation of the Super System Code (SSC), the Fast Flux Test Facility (FFTF) scram to natural circulation tests were simulated using SSC. A previous assessment of these simulations, was limited to short time scales (0 to 6 minutes) and concentrated on in-vessel parameters, in particular, the coolant temperatures in the fueled open test assemblies (FOTA's). In the short term, SSC predictions were found to be in good agreement with the experimental data. This report summarizes the results of the comparisons over the long term (60 minutes) and concentrates on the various loop parameters, hot leg temperatures, cold leg temperatures, and loop flow rates. For all tests, SSC predictions were in excellent agreement with the test results.

26005 **(BNL-NUREG—34267) Assessment of TRAC and RELAP5 codes with ORNL POST-CHF tests.** Rohatgi, U.S.; Neymotin, L.; Pu, J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-840614—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006756.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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Brookhaven National Laboratory is involved in assessing thermohydraulic models in various advanced codes such as TRAC-PF1 (Version 7), TRAC-BD1 (Version 12) and RELAP5/MOD1/CY=14. These codes have two fluid formulations and detailed descriptions of wall heat transfer regimes. These wall heat transfer models and correlations were developed using results from separate effect tests for specific fluid conditions and should be assessed for conditions which may exist in the reactor at normal and abnormal operation. In this paper the effort is concentrated on evaluating the capabilities of these codes in predicting the critical heat flux situa-

tion in the rod bundle geometry. The tests selected for this purpose are Oak Ridge Post-CHF tests. Oak Ridge Post-CHF tests consist of a series of high pressure and high temperature steady-state experiments and were conducted with water flowing upward through an 8 x 8 rod bundle with rod diameter and rod pitch typical of PWRs with 17 x 17 fuel assemblies.

26006 **(BNL-NUREG—34430) Strippable coating used for the TMI-2 reactor building decontamination.** Adams, J.W.; Dougherty, D.R.; Barletta, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 5p. (CONF-840307—29). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010516.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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Strippable coating material used in the TMI-2 reactor building decontamination has been tested for Sr, Cs, and Co leachability, for radiation stability, thermal stability, and for resistance to biodegradation. It was also immersion tested in water, a water solution saturated with toluene and xylene, toluene, xylene, and liquid scintillation counting (LSC) cocktail. Leach testing resulted in all of the Cs and Co activity and most of the Sr activity being released from the coating in just a few days. Immersion resulted in swelling of the coating in all of the liquids tested. Gamma irradiation and heating of the coating did not produce any apparent physical changes in the coating to 1×10^8 rad and 100°C; however, gas generation of H_2, CO, CO_2 was observed in both cases. Biodegradation of the coating occurred readily in soils as indicated by monitoring CO_2 produced from microbial respiration. These test results indicate that strippable coating radwaste would have to be stabilized to meet the requirements for Class B waste outlined in 10 CFR Part 61 and the NRC Draft Technical Position on Waste Form.

26007 **(BNL-NUREG—34502) Structural reliability analysis and seismic risk assessment.** Hwang, H.; Reich, M.; Shinozuka, M. (Brookhaven National Lab., Upton, NY (USA); Columbia Univ., New York (USA). Dept. of Civil Engineering and Engineering Mechanics). 1984. Contract AC02-76CH00016. 6p. (CONF-840647—15). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010891.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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This paper presents a reliability analysis method for safety evaluation of nuclear structures. By utilizing this method, it is possible to estimate the limit state probability in the lifetime of structures and to generate analytically the fragility curves for PRA studies. The earthquake ground acceleration, in this approach, is represented by a segment of stationary Gaussian process with a zero mean and a Kanai-Tajimi Spectrum. All possible seismic hazard at a site represented by a hazard curve is also taken into consideration. Furthermore, the limit state of a structure is analytically defined and the corresponding limit state surface is then established. Finally, the fragility curve is generated and the limit state probability is evaluated. In this paper, using a realistic reinforced concrete containment as an example, results of the reliability analysis of the containment subjected to dead load, live load and ground earthquake acceleration are presented and a fragility curve for PRA studies is also constructed.

26008 **(BNL-NUREG—34544) Identification of dose-reduction techniques for BWR and PWR repetitive high-dose jobs.** Dionne, B.J.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-840614—49). NTIS, PC A02/MF A01 - GPO; GPO Dep. Order Number DE84010894.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

As a result of concern about the apparent increase in collective radiation dose to workers at nuclear power plants, this project will provide information to industry in preplanning for radiation protection during maintenance operations. This study identifies Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR) repetitive jobs, and respective collective dose trends and dose reduction techniques. 3 references, 2 tables. (ACR)

26009 **(BNL-NUREG—34563) Diffusion of molybdenum through H-451 graphite.** Lee, B.S.; Uneberg, G.; Sastre, C. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-840614—48). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010466.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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Diffusion rates of molybdenum through graphite were determined in the temperature range of 2250°C to 3300°C. This work was conducted to characterize the behavior of fission products under an unrestricted core heat-up accident condition in a HTGR (High Temperature Gas Cooled Reactor).

26010 (CONF-830528—Vol.1, pp 792-799) **Transportation of the reactor vessel/internals of retired nuclear power plants as a single package.** Rainisch, R.; Michejda, O. (Burns and Roe, Inc., Paramus, NJ). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The transportation of the RPV/Internals of decommissioned nuclear power plants as a single package from the reactor site to the selected burial site via barge is a feasible alternative, providing navigable waterways are available. All prerequisites for executing such a shipment, such as disassembly, package strength and tightness, shielding, weight handling, and qualification of package, can be accomplished. The technology for carrying out the one-piece removal/transportation alternative is available, and there are no major technical obstructions with the proposed action. 5 references, 3 tables.

26011 (CONF-830528—Vol.2, pp 1477-1485) **Packaging, transportation and disposal of nuclear parts from decommissioning of NS Otto Hahn.** Viecenz, H.J. (Gg. Noell GmbH, Wuerzburg, Germany); Obst, J.; Krieger, F.; Lettnin, H.K.J. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

With NS OTTO HAHN for the first time a nuclear propelled merchant vessel has been regularly decommissioned after more than 10 years of successful operation. Basing on the concept of the total decontamination approximately 1100 Mg of contaminated and decontaminated components have been dismantled and removed from board ship. 260 Mg of contaminated components packed in 10 ft containers and 400-liter drums and the 480 Mg RPV unit are stored at the GKSS site for post investigations. A total mass of approximately 370 Mg has been decontaminated by mechanical and chemical procedures below the required radiological limits. The nuclear status of OTTO HAHN has been removed by the competent licensing authority in June 1982 so that the vessel is now offered for sale for conventional operations.

26012 **(CONF-840412—3) Key asset - inherent safety of LMFBR Pool Plant.** Marchaterre, J.F.; Sevy, R.H.; Lancet, R.T.; Mills, J.C. (Argonne National Lab., IL (USA); Rockwell International Corp., Canoga Park, CA (USA)). Apr 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010529.

From American power conference; Chicago, IL, USA (24 Apr 1984).

The safety approach used in the design of the Large Pool Plant emphasizes use of the intrinsic characteristics of Liquid Metal Fast Breeder Reactors to incorporate a high degree of safety in the design and reduce cost by providing simpler (more reliable) dedicated safety systems. Correspondingly, a goal was not to require the action of active systems to prevent significant core damage and/or provide large grace periods for all anticipated transients. The key safety features of the plant are presented and the analysis of representative flow and power transients are presented to show that the design goal has been satisfied.

26013 (CONF-840614—1) In-pile loss-of-flow TREAT test L05 with prototype fast reactor fuel. Robinson, W.R.; Bauer, T.H.; Stanford, G.S.; Wright, A.E.; Bowen, G.R.; Cooper, A.A.; Herbert, R.; Woods, W.J. (Argonne National Lab., IL (USA); UKAEA Atomic Energy Research Establishment, Harwell). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE84004017.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

In assessing the safety of liquid metal fast breeder reactors, various extremely-low-probability hypothetical core-disruptive accidents, with postulated events that might challenge containment and lead to release of radioactive material, are considered. Test L05, conducted in Argonne National Laboratory's Transient Reactor Test Facility (TREAT) with UK Prototype Fast Reactor (PFR) fuel, simulated one such accident. L05 was an in-pile, transient-undercooling-driven overpower (TUCOP) test within the PFR/TREAT collaborative program between the USDOE and the UKAEA. Seven grid-spaced full length, bottom-plenum fuel pins containing annular pellets of mixed oxide were tested to destruction in a Mark-IIIC integral loop with a flowing sodium environment. The UK manufactured fuel was preirradiated in the PFR to an axial peak burn-up of 4.2 a/o.

26014 (CONF-840614—8) Development of the three-dimensional SHAPS code capabilities for application to LMFBR piping systems. Zeuch, W.R.; Wang, C.Y. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005427.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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The SHAPS code couples three-dimensional pipe elements and elbows with two-dimensional hydrodynamics in order to account for fluid-structure interaction, motion of fluid due to moving pipes, and deformation of the structure. Each pipe element is formulated with eight degrees of freedom per node to consider translation, rotation, and membrane bending and breathing modes of the structure in order to calculate the stresses arising from internal pressurization as well as the three-dimensional flexural motion of the piping system.

26015 (CONF-840614—38) Plugging of intersubassembly gaps by downward flowing molten steel. Sienicki, J.J.; Spencer, B.W. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006744.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

In the assessment of the meltout phase of an LMFBR hypothetical core disruptive accident, a pathway for the escape of molten fuel from the disrupted core is provided by the narrow channels separating adjacent subassemblies. However, the removal of fuel through intersubassembly gaps might be impeded by steel blockage formation, if molten steel is postulated to enter the gap network ahead of disrupted fuel. Reported here are the results of an analysis of the conduction freezing controlled penetration behavior of molten steel flowing downward through the voided (of sodium) gap channels nominally separating adjacent subassemblies below the active core region. The objective is to determine the range of conditions under which the steel is predicted to be deposited as a thin crust on the channel walls leaving an open pathway remaining for subsequent fuel flow instead of forming a complete plug which closes off the gap channel and obstructs fuel removal immediately thereafter.

26016 (CONF-840647—6) Analysis of complex vessel experiments using the Hybrid Lagrangian-Eulerian containment code ALICE-II. Wang, C.Y.; Ku, J.L.; Zeuch, W.R. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 43p. NTIS, PC A3/MF A01; 1; GPO Dep. Order Number DE84007277.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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This paper describes the ALICE-II analysis of and comparison with complex vessel experiments. Tests SM-2 through SM-5 were performed by SRI International in 1978 in studying the structural response of 1/20 scale models of the Clinch River Breeder Reactor to a simulated hypothetical core-disruptive accident. These experiments provided quality data for validating treatments of the nonlinear fluid-structure interactions and many complex excursion phenomena, such as flow through perforated structures, large material distortions, multi-dimensional sliding interfaces, flow around sharp corners, and highly contorted fluid boundaries. Correlations of the predicted pressures with the test results of all gauges are made. Wave characteristics and arrival times are also compared. Results show that the ALICE-II code predicts the pressure profile well. Despite the complexity, the code gave good results for the SM-5 test.

26017 (CONF-840647—7) System seismic analysis of an innovative primary system for a large pool type LMFBR plant. Pan, Y.C.; Wu, T.S.; Cha, B.K.; Burelbach, J.; Seidensticker, R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007272.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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The system seismic analysis of an innovative primary system for a large pool type liquid metal fast breeder reactor (LMFBR) plant is presented. In this primary system, the reactor core is supported in a way which differs significantly from that used in previous designs. The analytical model developed for this study is a three-dimensional finite element model including one-half of the primary system cut along the plane of symmetry. The model includes the deck and deck mounted components,the reactor vessel, the core support structure, the core barrel, the radial neutron shield, the redan, and the conical support skirt. The sodium contained in the primary system is treated as a lumped mass appropriately distributed among various components. The significant seismic behavior as well as the advantages of this primary system design are discussed in detail.

26018 (CONF-8404133—2) RETRAN02/MOD02: an outside perspective. Wei, T.Y.C. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010518.

From 3. international RETRAN meeting; Las Vegas, NV, USA (9 Apr 1984).

ANL recently participated in a review of the RETRAN02/MOD02 code to determine the range of accuracy, the reliability and the reproducibility of results obtained with the code for Chapter 15 non-LOCA system transients for both pressurized water reactors (PWRs) and boiling water reactors (BWRs). This paper summarizes the technical aspects of that review.

26019 (EGG-TMI—6531-Rev.1) TMI-2 core debris grab sample quick look report. Akers, D.W.; Nitschke, R.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011032.

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Examinations are being performed to acquire data on the extent and nature of the damage and the post-accident condition of the TMI-2 core. One of the tasks is the examination of the six core debris grab samples acquired during the fall of 1983. Preliminary examination of five of the core debris samples has been completed at the INEL. This examination consisted of photo-visual and weighing of the as-received bulk samples. Additionally photo-visual, weighing, gamma spectroscopy and fissile determination were performed on eight select particles removed from these samples. This report presents and discusses the results from these measurements. Further analyses, primarily chemical and elemental, will be performed in FY-1984. Observation of the debris samples showed fuel pellet fragments, shards of cladding or guide tubes, previously molten material, and fuel pellet surfaces glazed with previously liquified material. Five of the eight particles were composed primarily of fuel. Radionuclides ^{144}Ce, ^{106}Ru, and ^{154}Eu appeared to be associated with the fuel while ^{137}Cs and ^{125}Sb were

released from the fuel and associated with the other nonfuel core materials.

26020 **(EUR—6975) LOBI: Influence of PWR primary loops on blowdown, first results. Final report.** Riebold, W.L.; Staedtke, H. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 69p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700967.

The LOBI test facility and the experimental programme are described with particular emphasis on the test facility design rationale and the programme objectives. The future small break test programme and the test facility modifications required for these tests are briefly referenced. The present status of the LOBI project is oultined by summarizing the four test series performed so far which were concerned with large break A1-tests, with small break scoping tests, and with large break A2- and B-tests in the framework of an interim test programme; all these tests were executed with the large downcomer. The fourth series presently being performed is concerned with large break A1-tests with the small downcomer. Analysis results are presented of the comparison between prediction and experimental data of the very first LOBI test A1-04 which was used for a special, blind post-test prediction exercise with international participation (LOBI PREX).

26021 **(EUR—8118) Analysis and synthesis of the theoretical studies performed on the control and safety of LWR's burning plutonium fuel. Final report.** Basselier, J.; Renard, A.; Holzer, R.; Hnilica, K. (Commission of the European Communities, Luxembourg). 1982. 368p. NTIS (US Sales Only), PC A16/MF A01. Order Number DE84700963.

This report presents the comparative investigations of parameters for plutonium fueled power stations (PWR and BWR) under steady state and dynamic conditions for typical accidents. The recycling of about 30% of mixed oxide fuel in the large LWR cores should not induce special problems, if some cautions are taken in core design to minimize the differences with UO_2 cores taking into account a limited margin fo uncertainty. The influence on the core behaviour, during the investigated accidents, is not very important and does not induce restrictions for at least a 30% Pu fraction in the core. The operation with high plutonium amounts may be considered. From the steady state and safety point-of-views, the maximum allowable quantity into the cores should be sought for each reactor. In principle, a 100% UO_2-PuO_2 core could be operated under certain conditions of loading pattern and shutdown margins. For what concerns the storage and handling, the studies show the following results: storage pool design with respect to criticality will not be affected by the use of UO_2-PuO_2 fuel asemblies.

26022 **(HEDL-SA—3050) Seismic response and damping tests of small bore LMFBR piping and supports.** Barta, D.A.; Anderson, M.J.; Severud, L.K.; Lindquist, M.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76FF02170. 11p. (CONF-840647—12). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008498.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Seismic testing and analysis of a prototypical Liquid Metal Fast Breeder Reactor (LMFBR) small bore piping system is described. Measured responses to simulated seismic excitations are compared with analytical predictions based on NRC Regulatory Guide 1.61 and measured system damping values. The test specimen was representative of a typical LMFBR insulated small bore piping system, and it was supported from a rigid test frame by prototypic dead weight supports, mechanical snubbers and pipe clamps.

26023 **(Juel-Spez—222) Investigation of the earthquake behavior of the research reactor FRJ-2 (DIDO).** Graffi, H.; Altes, J.; Koschmieder, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Oct 1983. 24p. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.).

A study prepared for the Federal Ministry of the Interior, entitled "Measures for Controlling External Impact Accidents in Research Reactors and Their Technical Support Structures" (SR 276) also contains engineering assessments of the behaviour of the FRJ-2 under seismic loads. These lead to the conclusion "that the integrity of the plant does not seem to be guaranteed in every case after an earthquake". Very detailed finite element calculations have been carried out in order to verify this statement and the results indicate that displacement of approx. 5 mm occurring during a 0.25 g safe shutdown earthquake for the reactor block both in the horizontal and vertical direction, as well as of approx. 16 mm for the craneway in the horizontal direction, do not endanger the primary circuit. The stresses only exceed the yield point in a few structural components (tube supports - row A of the experimental platform and tangential roof supports). In the case of the tube supports, however, the rupture point is also exceeded. In view of the fact that the present computations involve a number of conservatisms and that the DIDO design contains safety reserves, it can be assumed that the integrity of the primary circuit will remain ensured. More extensive studies of earthquake behaviour are therefore not considered to be necessary.

26024 (LA—9911-C-Vol.1, pp 31-39) **Fire protection design in CANDU nuclear power plants.** Lee, S.P. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

This paper presents the experience and design philosophy of fire protection in Canadian nuclear power plants. Our fire records and design concepts are discussed. An example of how the design concepts are applied is given.

26025 (LA—9911-C-Vol.2, pp 301-307) **Browns Ferry fire.** Harkleroad, J.R. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

A synopsis of the March 22, 1975 fire at Browns Ferry Nuclear Plant is discussed. Emphasis is placed on events prior to and during the fire. How the fire started, fire fighting activities, fire and smoke development, and restoration activities are discussed.

26026 (LA—9911-C-Vol.2, pp 309-316) **July 17, 1977, off-gas system charcoal adsorber bed fire at Browns Ferry Nuclear Plant.** Crisler, H.E. Jr. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

This discussion begins with a brief description of the condenser off-gas system used at Browns Ferry Nuclear Plant, then covers the fire event of July 17, 1977, and conclusions drawn after a study of the event. It concludes with a discussion of the corrective action intended to prevent recurrence.

26027 (LA—9911-C-Vol.2, pp 317-334) **Ignition properties of nuclear grade activated carbons.** Freeman, W.P.; Hunt, J.R.; Kovach, J.L. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The ignition property of new activated carbons used in air cleaning systems of nuclear facilities has been evaluated in the past, however very little information has been generated on the behavior of aged, weathered carbons which have been exposed to normal nuclear facility environment. Additionally the standard procedure for evaluation of ignition temperature of carbon is performed under very different conditions than those used in the design of nuclear air cleaning systems. Data were generated evaluating the ageing of activated carbons and comparing their $CH_3{}^{131}I$ removal histories to their ignition temperatures. A series of tests were performed on samples from one nuclear power reactor versus use time, a second series evaluated samples from several plants showing the variability of atmospheric effects. The ignition temperatures were evaluated

simulating the conditions existing in nuclear air cleaning systems, such as velocity, bed depth, etc., to eliminate potential confusion resulting from artifically set current standard conditions.

26028 (LA—9911-C-Vol.2, pp 375-389) **Cable tray fire experimentation.** Chavez, J.M.; Klamerus, L.J. (Sandia National Labs., Albuquerque, NM). Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Sandia National Laboratories has been conducting fire protection research for the US Nuclear Regulatory Commission since 1975. This research has been done to determine certain characteristics and properties of cable tray fires and cables since they pose a threat as a major fuel source for fires in nuclear power plants. The experimentation program has included testing separation distances between cable trays, the effects of fire retardant coatings and various types of barriers when the cable trays were subject to electrically initiated and exposure fires. Testing to determine the effectiveness of various suppression agents and methods for suppressing cable tray fires as well as seal penetration tests to evaluate cable penetrations at positive and negative pressures were also conducted. Finally, testing and analysis of the 20-ft horizontal separation requirement for redundant safety systems in nuclear power plants was also done. This paper presents a summary of the tests and results of all the programs mentioned.

26029 (LA—9911-C-Vol.2, pp 435-452) **Fire and explosion protection of air cleaning systems.** Dillmann, H.G. (Kerforschungszentrum Karlsruhe, Germany); Pasler, H.; Plitt, U. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Within the framework of investigations into the post-accident filtration of the containment, filter components have been developed to withstand high challenges, e.g. from temperature, radiation, moisture, loading, and which are capable to resist shock over-pressure. Other measures presented to protect ventilation systems against increases inpressure and explosions are extremely quick-acting valves.

26030 (LA—9911-C-Vol.2, pp 453-465) **Preventing and suppressing Explosions in a BWR off-gas line with Explosafe.** Letschert, P.J.C. (N.V. GKN, Dodewaard, Netherlands); Scholten, L.C. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The possibilities to further decrease the hazard of explosion in the off-gas system of the Dodewaard Reactor have been explored. In particular, the properties of Explosafe, a filler material, have been investigated. As a result of the investigation, the use of fillers in the off-gas line has been abandoned and replaced with other passive measures.

26031 **(LA-UR—84-1319) Hydrogen diffusion flames burning in a Mark-III containment design.** Travis, J.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 33p. (CONF-840813—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011411.

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

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A time-dependent, fully three-dimensional analysis of hydrogen diffusion flames combusting in nuclear reactor containments has been performed. The analysis involves coupling an Eulerian finite-difference fluid dynamic technique with the global chemical kinetics of hydrogen combustion. The overall induced flow patterns are shown to be very complex and greatly influence the maximum wet-well tempertures and pressures and wall heat fluxes.

26032 **(NKA—83-3) Safety research in energy-production field. Yearly report for 1982. Nordic project cooperation.** (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). Mar 1983. 103p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84700936.

1982 has been the second year of the Nordic safety project implementation. 19 project groups and 28 organizations participate in efforts to make nuclear power production even more safe and reliable than it has been hitherto. Research program covers five different fields: Reactor safety, human reliability, quality assurance, radioactive wastes in emergency cases, and radioecology project for efforts of nuclear power generation. The Nordic transport research group was subsidized by NKA budget. Economy analysis and new administrative regulations as well as program control, preliminary studies and reporting of national results, are planned by the respective subcommittees.

26033 **(NUREG—0090-Vol.6-No.3) Report to Congress on abnormal occurrences, July-September 1983.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Apr 1984. 55p. NTIS, PC A04/MF A01 - GPO*. Order Number DE84901210.

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For this report period, there were three abnormal occurrences at the nuclear power plants licensed by the NRC to operate. The first involved large diameter pipe cracking in boiling water reactors; the second involved an uncontrolled leakage of reactor coolant outside primary containment; and the third involved improper control rod manipulations. There were seven abnormal occurrences for the other NRC licenses. Three involved overexposures; two involved medical misadministrations; one involved widespread radiological contamination; and one involved willful violation of license and a material false statement to the NRC. There were no abnormal occurrences reported by the Agreement States. The report also contains information updating some previously reported abnormal occurrences.

26034 **(NUREG—0519-Suppl.8) Safety Evaluation Report related to the operation of LaSalle County Station, Units 1 and 2. Docket Nos. 50-373 and 50-374.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1984. 25p. NTIS, PC A02/MF A01 - GPO* - $3.50. Order Number DE84920214.

This supplement to the Safety Evaluation Report of Commonwealth Edison Company's application for a license to operate its La Salle County Station, Unit 2, located in Brookfield Township, La Salle County, Illinois, has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement is to update evaluations on Unit 2 issues identified in the previous Safety Evaluation Report and Supplements that need resolution prior to issuance of the full power operating license for Unit 2.

26035 **(NUREG—0732-Rev.1) Answers to frequently asked questions about cleanup activities at Three Mile Island, Unit 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1984. 56p. NTIS, PC A04/MF A01 - GPO* $4.25. Order Number DE84901131.

This question-and-answer report provides answers in nontechnical language to frequently asked questions about the status of cleanup activities at Three Mile Island, Unit 2. The answers update information first prepared in 1981, shortly after the cleanup got under way. Since then, a variety of important developments in the cleanup has occurred. The information in the report should be read in conjunction with NUREG 1060, a discussion of increased occupational exposure estimates for the cleanup. The questions and answers in this report cover purpose and community involvement, decontamination of water and reactor, fuel removal, radwaste transport, environmental impact, social and economic effects, worker exposures and safety, radiation monitoring, potential for accidents, and schedule and funding.

26036 (NUREG—0830-Suppl.3) Safety evaluation report related to the operation of Callaway Plant, Unit No. 1 (Docket No. STN 50-483). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1984. 194p. NTIS, PC A09/MF A01 - GPO* $6.00. Order Number DE84901125.

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This report supplements the Safety Evaluation Resport (SER) for the application filed by the Union Electric Company, as applicant and agent for itself, for a license to operate the Callaway Plant, Unit 1 (Docket No. STN 50-483). This report as been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Callaway County, Missouri. This supplement provides recent information regarding resolution of the open items identified in the SER. Because of the favorable resolution of the items discussed in this report, the staff concludes that the facility can be operated by the applicant without endangering the health and safety of the public.

26037 (NUREG/CR—2552) CRAC2 model description. Ritchie, L.T.; Alpert, D.J.; Burke, R.P.; Johnson, J.D.; Ostmeyer, R.M.; Aldrich, D.C.; Blond, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 98p. (SAND—82-0342). NTIS, PC A05; 3 - GPO; GPO Dep. Order Number DE84010557.

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The CRAC2 computer code is a revised version of CRAC (Calculation of Reactor Accident Consequences) which was developed for the Reactor Safety Study. This document provides an overview of the CRAC2 code and a description of each of the models used. Significant improvements incorporated into CRAC2 include an improved weather sequence sampling technique, a new evacuation model, and new output capabilities. In addition, refinements have been made to the atmospheric transport and deposition model. Details of the modeling differences between CRAC2 and CRAC are emphasized in the model descriptions.

26038 (NUREG/CR—2921) Chemical interactions of tellurium vapors with reactor materials. Sallach, R.A.; Greenholt, C.J.; Taig, A.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 70p. (SAND—82-1145). NTIS, PC A04/MF A01 - GPO; GPO Dep. Order Number DE84011133.

The reaction of tellurium vapor with 304 stainless steel and Inconel-600 alloys in an as-received state and in a preoxidized state was studied for the temperature range 500°C to 800°C. Most reaction products were identified. The reaction is fast and appears largely limited by tellurium transport through the surrounding gas phase. Also studied are the reactions of tellurium vapor with silver Zircaloy-2. Tellurium desorption rates from solid solutions of tellurium in nickel and 304 stainless steel were measured. The FLATDEP model for calculating tellurium deposition profiles is presented.

26039 (NUREG/CR—3023) Molten thermite teeming into an iron oxide particle bed. Tarbell, W.W.; Blose, R.E.; Arellano, F.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 79p. (SAND—82-2475). NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84011675.

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The two particle bed tests employed 10-kg thermite melts (2700°K) teemed into a bed of iron oxide particles. Objective was to investigate bed penetration, particle flotation and fracture, and heat flux partitioning. The results show that the hydraulic forces exerted by the melt did not immediately displace the bed. Bed penetration was by melting and absorbing of the particles with the major portion of the displaced iron oxide terminating in the alumina phase of the melt. The movement of the penetration front suggests the movement to be a series of melt/freeze/remelt processes. The large grain structure of the iron phase indicates that the cooling was slow and continuous. A coherent 1-cm-thick layer of iron oxide in contact with the melt was created by sintering of the particles. The particle size of the unaffected portions of the bed showed very little fracturing due to thermal stress and slightly over 7% particle growth due to sintering. The calculated heat flux values to the surrounding crucible structure suggest that the bed is effective in delaying and reducing the magnitude of the peak heat flux values.

26040 (NUREG/CR—3307-Vol.3) Reactor safety research programs. Quarterly report, July-September 1983. Edler, S.K. (ed.). (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 64p. (PNL—4705-3). NTIS, PC A04/MF A01 - GPO $4.50; GPO Dep. Order Number DE84011212.

Evaluations of nondestructive examination (NDE) techniques and instrumentation include demonstrating the feasibility of determining the strength of structural graphite, evaluating the feasibility of detecting and analyzing flaw growth in reactor pressure boundary systems, and examining NDE reliability and probabilistic fracture mechanics. Accelerated pellet-cladding interaction modeling is being conducted to predict the probability of fuel rod failure under normal operating conditions. Experimental data and analytical models are being provided to aid in decision making regarding pipe-to-pipe impacts following postulated breaks in high-energy fluid system piping. Experimental data and validated models are being used to determine a method for evaluating the acceptance of welded or weld-repaired stainless steel piping. Thermal-hydraulic models are being developed to provide better digital codes to compute the behavior of full-scale reactor systems under postulated accident conditions. High-temperature materials property tests are being conducted to provide data on severe core damage fuel behavior. Severe fuel damage accident tests are being conducted at the NRU reactor, Chalk River, Canada; and an instrumented fuel assembly irradiation program is being performed at Halden, Norway. Fuel assemblies and analytical support are being provided for experimental programs at other facilities, including the Super Sara Test Program, Ispra, Italy, and experimental programs at the Power Burst Facility.

26041 (NUREG/CR—3350) LOCA simulation in the national research universal reactor program: postirradiation examination results for the third materials experiment (MT-3). Rausch, W.N. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 66p. (PNL—4933). NTIS, PC A04/MF A01 - GPO $4.50; GPO Dep. Order Number DE84010898.

A series of in-reactor experiments were conducted using full-length 32-rod pressurized water reactor (PWR) fuel bundles as part of the Loss-of-Coolant Accident (LOCA) Simulation Program. The third materials experiment (MT-3) was the sixth in the series of thermal-hydraulic and materials deformation/rutpure experiments conducted in the National Research Universal (NRU) reactor, Chalk River, Ontario, Canada. The main objective of the experiment was to evaluate ballooning and rupture during active two-phase cooling in the temperature range from 1400 to 1500°F (1030 to 1090 K). The 12 test rods in the center of the 32-rod bundle were initially pressurized to 550 psi (3.8 MPa) to insure rupture in the correct temperature range. All 12 of the rods ruptured, with an average peak bundle strain of ~ 55%. The UKAEA also funded destructive postirradiation examination (PIE) of several of the ruptured rods from the MT-3 experiment. This report describes the work performed and presents the PIE results. Information obtained during the PIE included cladding thickness measurements metallography, and particle size analysis of the cracked and broken fuel pellets.

26042 (NUREG/CR—3379) SLAM: a sodium-limestone concrete ablation model. Suo-Anttila, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1983. Contract AC04-76DP00789. 77p. (SAND—83-7114). NTIS, PC A05/MF A01 - GPO; GPO Dep. Order Number DE84011132.

SLAM is a three-region model, containing a pool (sodium and reaction debris) region, a dry (boundary layer and dehydrated concrete) region, and a wet (hydrated concrete) region. The model includes a solution to the mass, momentum, and energy equations in each region. A chemical kinetics model is included to provide heat sources due to chemical reactions between the sodium and the concrete. Both isolated model as well as integrated whole code evalua-

tions have been made with good results. The chemical kinetics and water migration models were evaluated separately, with good results. Several small and large-scale sodium limestone concrete experiments were simulated with reasonable agreement between SLAM and the experimental results. The SLAM code was applied to investigate the effects of mixing, pool temperature, pool depth and fluidization. All these phenomena were found to be of significance in the predicted response of the sodium concrete interaction. Pool fluidization is predicted to be the most important variable in large scale interactions.

26043 **(NUREG/CR—3511-Vol.1) Interim reliability evaluation program. Analysis of the Calvert Cliffs Unit 1 Nuclear Power Plant. Volume 1, main report.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 271p. (SAND—83-2086-Vol.1). NTIS, PC A12/MF A01 - GPO; GPO Dep. Order Number DE84011259.

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The analysis used fault tree and event tree models as the primary tools to evaluate the risk due to a core melt at Calvert Cliffs. Core melt sequences initiated by one of three break-size LOCAs or one of six categories of transients were evaluated, and the dominant (i.e., highest frequency) sequences were further analyzed to estimate the magnitude and frequency of radionuclide release. The accident sequences were then placed into the release categories defined in the Reactor Safety Study. The most significant sequences contributing to the core melt frequency are (1) Anticipated Transients Without Scram (ATWS) (33% of the total core melt frequency), (2) Small-small LOCAs 1.9 to 3 in. in diameter) with makeup system failure in the recirculation phase (20% of the total core melt frequency), (3) the loss of a DC bus followed by failure of secondary heat removal (16% of the total core melt frequency), and (4) Loss of Offsite Power following by failure of secondary heat removal or a stuck open relief valve (12% of the total core melt frequency. Insights were developed concerning the importance of plant design features. The analysis led to the identification of key components/events, that contribute most to the core melt frequency. Similar insights were developed concerning plant operations. Operator errors made during the course of accidents were found to be significant. Some changes to plant procedures could be made in order to take greater advantage of possible operator actions. Operator recovery actions were very important in preventing or mitigating accidents. Test and maintenance contributions were, in general, small; however, maintenance of several key components was found to be a significant contributor to particular sequences. The estimated core melt frequency is similar to the values predicted by probabilistic risk assessments of other pressurized water reactors.

26044 **(NUREG/CR—3526) Impact of changes in damping and spectrum peak broadening on the seismic response of piping systems.** Chuang, T.Y.; Lu, S.C.; Benda, B.J.; Johnson, J.J. (Lawrence Livermore National Lab., CA (USA)). Dec 1983. Contract W-7405-ENG-48. 67p. (UCRL—53491). NTIS, PC A04/MF A01 - GPO; GPO Dep. Order Number DE84006514.

The seismic response of piping systems in nuclear power plants is commonly separated into two parts - the inertial or dynamic response and the pseudostatic response due to relative motions of the systems supports. Various analysis procedures have been developed to calculate each portion of the response separately. The present study investigates calculational procedures and parameter values used for the calculation of the inertial response component. It also investigates the possibility of removing snubbers and restraints in piping systems. Removal of snubbers and restraints will reduce the seismic stresses due to relative support motions. The scope of the present study was to evaluate the PVRC-proposed changes relative to piping responses calculated by response-spectrum methodology and a multi-support time history analysis procedure which is less conservative because it does not require any form of enveloping of support motions. Numerous response-spectrum analyses of three selected piping systems in Zion nuclear power plant were performed, using different combinations of damping values (RG 1.61 and proposed PVRC), peak-broadening (RG 1.22), and the alternative to peak broadening (proposed PVRC).

26045 **(NUREG/CR—3539) Impact of containment building leakage on LWR accident risk.** Hermann, O.W.; Burns, T.J. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 18p. (ORNL/TM—8964). NTIS, PC A02/MF A01 - GPO; GPO Dep. Order Number DE84010319.

The consequences, or risks, from light-water reactor accidents have been evaluated as a function of containment building leakage rates. The analysis used the set of generic source terms and frequencies of occurrence developed as representative of the range of postulated types of accidents currently applied in reactor safety research, and the calculated result was the variable M/sub sp/, defined as the accident-spectrum-weighted impact fraction rate from containment building leakage. Explicitly, M/sub sp/ was formulated as the sum of fractional increases in consequences, due to the building leakage, for each type of accident weighted by its frequency of occurrence. The base case common to similar types of analyses was applied. The computed result was M/sub sp/ $\leq 1.5 \times 10^{-3}$ fractional increase in the accident spectrum risk per %/day containment building leakage rate.

26046 **(NUREG/CR—3564) Pressurized thermal shock: TEMPEST computer code simulation of thermal mixing in the cold leg and downcomer of a pressurized water reactor.** Eyler, L.L.; Trent, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 92p. (PNL—4909). NTIS, PC A05/MF A01; 1 - GPO $4.50; GPO Dep. Order Number DE84010654.

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The TEMPEST computer program was used to simulate fluid and thermal mixing in the cold leg and downcomer of a pressurized water reactor under emergency core cooling high-pressure injection (HPI), which is of concern to the pressurized thermal shock (PTS) problem. Application of the code was made in performing an analysis simulation of a full-scale Westinghouse three-loop plant design cold leg and downcomer. Verification/assessment of the code was performed and analysis procedures developed using data from Creare 1/5-scale experimental tests. Results of three simulations are presented. The first is a no-loop-flow case with high-velocity, low-negative-buoyancy HPI in a 1/5-scale model of a cold leg and downcomer. The second is a no-loop-flow case with low-velocity, high-negative density (modeled with salt water) injection in a 1/5-scale model. Comparison of TEMPEST code predictions with experimental data for these two cases show good agreement. The third simulation is a three-dimensional model of one loop of a full size Westinghouse three-loop plant design. Included in this latter simulation are loop components extending from the steam generator to the reactor vessel and a one-third sector of the vessel downcomer and lower plenum. No data were available for this case. For the Westinghouse plant simulation, thermally coupled conduction heat transfer in structural materials is included. The cold leg pipe and fluid mixing volumes of the primary pump, the stillwell, and the riser to the steam generator are included in the model. In the reactor vessel, the thermal shield, pressure vessel cladding, and pressure vessel wall are thermally coupled to the fluid and thermal mixing in the downcomer. The inlet plenum mixing volume is included in the model. A 10-min (real time) transient beginning at the initiation of HPI is computed to determine temperatures at the beltline of the pressure vessel wall.

26047 **(NUREG/CR—3596) Severe Accident Sequence Analysis (SASA) Program sequence event tree: boiling water reactor anticipated transient without scram.** Bruske, S.Z.; Wright, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 24p. (EGG—2288). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010548.

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A sequence event tree for a boiling water reactor anticipated transient without scram (ATWS) has been developed and quantified. Goal is to provide a logical representation of the systems that must respond to an ATWS, the required operator response to the event, operator actions that could be performed in response to multiple failures, and the phenomenological concerns. Purpose of the sequence event tree is to provide a basis upon which to perform additional deterministic thermal-hydraulic and core damage analy-

ses in the most cost effective manner based on the most likely sequence of events that will lead to containment/core damage. The ATWS sequence event tree is based on main steam isolation valve (MSIV) closure as the initiating event. The ATWS sequence event tree logic is based on three means to achieve low power or subcriticality: (a) early boron injection, (b) level control to top of active fuel and pressure control without boron injection, or (c) late boron injection that has been preceded with either level or pressure control.

26048 **(NUREG/CR—3633-Vol.1) TRAC-BD1/MOD1: an advanced best estimate computer program for boiling water reactor transient analysis. Volume 1. Model description.** Taylor, D.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 228p. (EGG—2294-Vol.1). NTIS, PC A11/MF A01; 1 - GPO; GPO Dep. Order Number DE84011148.

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The TRAC-BD1/MOD1 version of the computer code provides a best-estimate analysis capability for analyzing the full range of postulated accidents in boiling water reactor (BWR) systems and related experimental facilities. This version provides a consistent and unified analysis capability for analyzing all areas of a large or small break loss-of-coolant accident (LOCA), beginning with the blowdown phase, through heatup, reflood with quenching, and finally, the refill phase of the accident. Also provided is a basis capability for the analysis of operational transients up to and including anticipated transients without scram (ATWS) for which point reactor kinetics is adequate. Agreement between TRAC-BD1/MOD1 simulation of various test problems and measured data is excellent. The TRAC-BWR Code Development Program at INEL is developing versions of TRAC (Transient Reactor Analysis Code) to provide a best estimate capability for the analysis of postulated accidents and transients in BWR systems and related experimental facilities. The first released version of the code, TRAC-BD1, was developed to provide an analysis capability for design basis loss-of-coolant accidents (DBLOCAs). The second released version of the code, TRAC-BD1/MOD1 has been developed to provide an analysis capability for operational transients including ATWS as well as improving the analysis capability for both large and small break LOCAs.

26049 **(NUREG/CR—3633-Vol.2) TRAC-BD1/MOD1: an advanced best estimate computer program for boiling water reactor transient analysis. Volume 2. Users guide.** Shumway, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 123p. (EGG—2294-Vol.2). NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84010544.

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This Volume 2 of TRAC-BD1/MOD1 describes the input and output of the computer code and provides user guidelines for use in modeling BWR systems. The input variables and format are described for each of the TRAC component models. A TRAC component is a specific piece of hardware such as a pump or a valve. User guidelines and suggestions are also presented for modeling specific BWR features.

26050 **(NUREG/CR—3644) Review of proposed failure criteria for ductile materials.** Ju, F.D.; Butler, T.A. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 34p. (LA—10007-MS). NTIS, PC A03/MF A01; 1 - GPO $3.75; GPO Dep. Order Number DE84011211.

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In this report, failure criteria for structural components constituting the primary coolant-system boundary of a Liquid Metal Fast Breeder Reactor (LMFBR) are reviewed. Because the materials being considered, mild ferritic steel and austenitic stainless steels, are ductile, especially under LMFBR normal operating and accident conditions, only ductile criteria are considered. The ductile criteria must be used in combination with true stress and strain measures of deformation and internal load. Specific criteria reviewed include maximum stress and strain or plastic instability based on uniaxial tensile-test data and a hole-growth theory based on coalescence of neighboring voids under load. Criteria based only on maximum stress or strain are not recommended for general use because they are not appropriate under general, multiaxial stress conditions. The plastic instability criterion, because it leaves a large unused toughness region before fracture, is recommended where considerable conservatism is warranted. The hole-growth criterion is recognized as being analytically sound; however, it has not been extended to general three-dimensional geometry and multiaxial stress conditions. The theory needs to be substantiated with experimental data for specific materials being considered.

26051 **(NUREG/CR—3650) Statistical analysis of nuclear power plant pump failure rate variability: some preliminary results.** Martz, H.F.; Whiteman, D.E. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 55p. (LA—10014-MS). NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. Order Number DE84008854.

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In-Plant Reliability Data System (IPRDS) pump failure data on over 60 selected pumps in four nuclear power plants are statistically analyzed using the Failure Rate Analysis Code (FRAC). A major purpose of the analysis is to determine which environmental, system, and operating factors adequately explain the variability in the failure data. Catastrophic, degraded, and incipient failure severity categories are considered for both demand-related and time-dependent failures. For catastrophic demand-related pump failures, the variability is explained by the following factors listed in their order of importance: system application, pump driver, operating mode, reactor type, pump type, and unidentified plant-specific influences. Quantitative failure rate adjustments are provided for the effects of these factors. In the case of catastrophic time-dependent pump failures, the failure rate variability is explained by three factors: reactor type, pump driver, and unidentified plant-specific influences. Finally, point and confidence interval failure rate estimates are provided for each selected pump by considering the influential factors. Both types of estimates represent an improvement over the estimates computed exclusively from the data on each pump.

26052 **(NUREG/CR—3652) Evaluation of instrumentation for detection of inadequate core cooling in boiling water reactors.** Lewin, J. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 35p. (ORNL/TM—9029). NTIS, PC A03/MF A01 - GPO; GPO Dep. Order Number DE84010429.

This report is a review of the Approach to Inadequate Core Cooling issue in Boiling Water Reactors (BWR). The report consists of seven sections. The principal conclusion is that the condition of the reference leg, and operator awareness of that condition are of primary importance in level indication reliability for safety. An indication of reference leg level and temperature displayed to the operators would be a useful enhancement of reliability and a guide to further operator action in all circumstances. We conclude that the BWR practice of multiple, redundant coolant level measurements, with overlapping ranges, can be a reliable basis for indication of approach to an ICC condition, and, in correlation with the other control and safety systems of modern BWRs, will prevent unsafe conditions.

26053 **(NUREG/CR—3661) Prototypical steam generator (MB-2) transient testing program. Task plan/scaling analysis report.** Young, M.Y.; Takeuchi, K.; Mendler, O.J.; Hopkins, G.W. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). Mar 1984. 200p. (EPRI-NP—3494; WCAP—10475). NTIS, PC A09/MF A01 - GPO* $6.00. Order Number DE84900679.

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This report describes the Westinghouse MB-2 model boiler test facility and the test program currently planned (with Westinghouse/EPRI/NRC funding) to investigate various types of possible accidents which might occur in a PWR steam generator. The planned tests will simulate loss of feedwater (LOF) transients, various steam generator tube rupture (SGTR) scenarios, and steamline breaks (SLB). The facility will be extensively modified to allow measurement of local wall and fluid temperatures, and to measure possible moisture carryover during the SLB and SGTR tests. This report is divided into six sections. The first three sections describe the facility and the new components and instrumentation to be in-

stalled. The next section is a detailed scaling analysis of MB-2. Section 5 describes the background and objectives of the tests, and section 6 describes the analysis of the data which if planned.

26054 **(NUREG/CR—3727) Fission product removal in Engineered Safety Feature (ESF) systems. Data base assessment and suggested experimental program.** Zaloudek, F.R.; Postma, A.K.; Winegardner, W.K. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 47p. (PNL—5050). NTIS (US Sales Only), PC A03/MF A01; 1 - GPO $4.00; GPO Dep. Order Number DE84011718.

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The available data base on the fission product removal capabilities of nuclear reactor Engineered Safety Feature (ESF) systems was reviewed and assessed. The systems considered included pressure suppression pools, ice condenser systems, containment sprays, filter systems and containment air coolers. Based on this assessment, a research program was recommended to expand this data base to support the development of mechanistic models and computer codes for the prediction of ESF system fission product removal. This research program included experimental efforts to better define the performance of ice condenser systems, expand the range of data available on water spray systems and to investigate the behavior of containment air coolers, demisters and fans in the presence of aerosols typical of those expected following a severe accident.

26055 **(PB—84-161843) Analytical modelling of hydrogen transport. Final report.** Manno, V.P.; Golay, M.W. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Oct 1983. 339p. (MIT-EL—83-009). NTIS, PC A15/MF A01.

A versatile computational model of hydrogen transport in nuclear plant containment buildings is developed. The background and significance of hydrogen-related nuclear safety issues are discussed. A computer program is constructed that embodies the analytical models. The thermo-fluid dynamic formulation spans a wide applicability range from rapid two-phase blowdown transients to slow incompressible hydrogen injection. Detailed ancillary models of molecular and turbulent diffusion, mixture transport properties, multi-phase multicomponent thermodynamics and heat sink modelling are addressed. The numerical solution of the continuum equations emphasizes both accuracy and efficiency in the employment of relatively coarse discretization and long time steps. Reducing undesirable numerical diffusion is addressed.

26056 **(SAND—83-2653C) Experimental facilities to study hydrogen combustion and detonation.** Fisk, J.W.; Sherman, M.P.; Tieszen, S.R.; Benedick, W.B. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840813—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008998.

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

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Two new combustion facilities developed at Sandia National Laboratories in Albuquerque are described. FLAME is a large horizontal channel designed to study problems in hydrogen combustion related to nuclear reactor safety, flame acceleration, transition to detonation, etc. Results from a series of 6 tests with 50% top venting and no obstacles in the channel are presented. The Heated Detonation Tube was developed to study hydrogen-air-steam detonations. Tests with hydrogen-air mixtures at ambient temperatures have achieved detonations down to 13.5% hydrogen.

26057 **(SAND—84-0130C) Visual observation of fuel and clad relocation during LMFBR transients.** Wright, S.A.; Pickard, P.S.; Schumacher, G.; Henkel, P. (Sandia National Labs., Albuquerque, NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 11 Jan 1984. Contract AC04-76DP00789. 6p. (CONF-840614—19). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006289.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The first experiment in the jointly-sponsored (NRC-KfK) STAR experiment program was completed November 9, 1983. The STAR program investigates the transient relocation of fuel and cladding during the initiation phase of LMFBR hypothetical accidents. The name STAR is an acronym for the Sandia Transient Axial Relocation experiments. The program focuses on the key initiation phase issue of material relocation, since it dominates the reactivity input during the early phases of LOF type LMFBR accidents. The STAR experiment capsule was designed to allow the direct observation of small fuel pin bundles through an in-pile optical system. The motion of fuel and cladding during the simulated LOF are recorded on a high speed 35 mm motion picture camera.

26058 **(TPR-NS—24-No.6) Nuclear safety, Vol. 24, No. 6. Technical progress review, November-December 1983.** Cottrell, W.B. (ed.). (Oak Ridge National Lab., TN (USA)). Nov 1983. 161p. GPO $6.50.

A separate abstract was prepared for each of the 8 articles included. (HDR)

26059 **(UCID—20053) Technical evaluation report on the seven main transformer failures at the North Anna Power Station, Units 1 and 2 (Docket Nos. 50-338, 50-339).** Dalton, K.J.; Kresser, J.V.; Savage, J.W.; Selan, J.C. (Lawrence Livermore National Lab., CA (USA)). 29 Mar 1984. Contract W-7405-ENG-48. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84008822.

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This report documents technical evaluations on various aspects pertaining to the seven main transformer failures at the North Anna Power Station, Units 1 and 2. These reports cover the subjects of Probability Risk Assessment (PRA), Failure Modes and Effects Analysis (FMEA), Root Causes, Protection Systems, Modifications, Failure Statistics, and Generic Aspects. The PRA determined that the contribution from a main transformer failure affecting plant safety systems so as to increase the risk to the public health and safety is negligible. The FMEA determined that a main transformer failure can have primary and secondary effects on plant safety system operation. The evaluation of the Root Causes found that no single common cause contributed to the seven failures. Each failure was found to have specific circumstances for initiating the failure. Both the generator and transformer primary protection systems were found to perform correctly and were designed within industry standards and practices. The proposed modifications resulting from the analyses of the failures will improve system reliability and integrity, and will reduce potentially damaging effects. The failure statistic survey found very limited data bases from which a meaningful correlation could be ascertained. The statistical comparison found no appreciable anomalies with the NAPS failures. The evaluation of all the available information and the results of the separate reports on the main transformer failures found that several generic concerns exist.

26060 **(UCID—20067) Response margins of the dynamic analysis of piping systems.** Johnson, J.J.; Benda, B.J.; Chuang, T.Y.; Smith, P.D. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010774.

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This report is organized as follows: Section 2 describes the three piping systems of the Zion nuclear power plant which formed the basis of the present study. The auxiliary feedwater (AFW) piping from steam generator to containment, the residual heat removal (RHR) and safety injection piping in the auxiliary building, and the reactor coolant loops (RCL) including a portion of the branch lines were analyzed. Section 3 describes the analysis methods and the analyses performed. Section 4 presents the numerical results; the principal results presented as comparisons of response calculated by best estimate time history analysis methods vs. the SRP response spectrum technique. Section 5 draws conclusions from the results. Appendix A contains a brief description of the mathematical models that defined the structures containing the three piping systems. Response from these models provided input to the piping models. Appendix B provides a detailed derivation of

the pseudostatic mode approach to the multisupport time history analysis method used in this study.

26061 **(UCRL—90116) Digraph matrix analysis applications to systems interactions.** Alesso, H.P.; Altenbach, T.; Lappa, D.; Kimura, C.; Sacks, I.J.; Ashmore, B.C.; Fromme, D.; Smith, C.F.; Williams, W. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 6p. (CONF-840614—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004815.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Complex events such as Three Mile Island-2, Brown's Ferry-3 and Crystal River-3 have demonstrated that previously unidentified system interdependencies can be important to safety. A major aspect of these events was dependent faults (common cause/mode failures). The term systems interactions has been introduced by the Nuclear Regulatory Commission (NRC) to identify the concepts of spatial and functional coupling of systems which can lead to system interdependencies. Spatial coupling refers to dependencies resulting from a shared environmental condition; functional coupling refers to both dependencies resulting from components shared between safety and/or support systems, and to dependencies involving human actions. The NRC is currently developing guidelines to search for and evaluate adverse systems interactions at light water reactors. One approach utilizes graph theoretical methods and is called digraph matrix analysis (DMA). This methodology has been specifically tuned to the systems interaction problem. The objective of this paper is to present results from two DMA applications and to contrast them with the results from more traditional fault tree approaches.

26062 **(UCRL—90166) Status, plans, and capabilities of the Nuclear Criticality Information System.** Koponen, B.L. (Lawrence Livermore National Lab., CA (USA)). 6 Jan 1984. Contract W-7405-ENG-48. 5p. (CONF-840614—13). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005893.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The Nuclear Criticality Information System (NCIS), in preparation since 1981, has substantially evolved and now contains a growing number of resources pertinent to nuclear criticality safety. These resources include bibliographic compilations, experimental data, communications media, and the International Directory of Nuclear Criticality Safety Personnel. These resources are part of the LLNL Technology Information System (TIS) which provides the host computer for NCIS. The TIS provides nationwide access to authorized members of the nuclear criticality community via interactive dial-up from computer terminals that utilize communication facilities such as commercial and federal telephone networks, toll-free WATS lines, TYMNET, and the ARPANET/MILNET computer network.

26063 **(UCRL—90514) Observations on seismic probabilistic risk assessments (PRAs).** Smith, P.D. (Lawrence Livermore National Lab., CA (USA)). Jun 1984. Contract W-7405-ENG-48. 8p. (CONF-840647—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011051.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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In this paper we present observations on a number of issues related to seismic PRAs including: strengths and weaknesses of seismic PRAs; uncertainty, sensitivity and variability; common misconceptions; possible improvements in seismic safety acceptance criteria; recommended modifications to the NRC approach to safety goals; and major problems. Some specific examples are provided.

26064 **(UNI—2022) Scram transient analysis (3/26/82).** Schultz, M.V. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 21 Apr 1982. Contract AC06-76RL01857. 9p. NTIS, PC A02; 3; GPO Dep. Order Number DE84009868.

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During adjustment of a megawatt meter by WPPSS personnel, the meter was inadvertently shorted. This caused a loss of power to CONDV-82-1, which closed causing the WPPSS deaerator level to drop. Loss of deaerator level initiated a secondary system upset that culminated in the scram of the reactor. Although the reactor was manually scrammed, an automatic scram from high secondary system pressure would have occurred due to the system upset. Scram transient responses are described.

26065 **(WINCO—1009) Guidance on offsite emergency radiation measurement systems. Phase 2: The milk pathway.** (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-84ID12435. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84008994.

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This document provides guidance to State and local governments and to Federal agencies on offsite emergency measurement of radionuclides after an accident involving a light-water nuclear power plant; in particular, this document provides guidance on determining the dose commitment from the milk pathway. Protective action levels proposed by the Food and Drug Administration (FDA) for milk are used as the basis for monitoring requirements. Measurement of radionuclides in milk should be made at the earliest practical point in the production chain: dairy farms, receiving and transfer stations, processing plants or marketing facilities. Early monitoring will provide data to keep significantly contaminated milk out of distribution and will provide the basis for the most timely emergency response action. Radioiodine plus four other radionuclides, cesium-134, cesium-137, strontium-89, and strontium-90, contribute significantly to dose via the milk pathway; of the most severe potential accident, the short-term dose via the milk pathway from radioiodine is significantly greater than that of cesium or strontium. There is no emergency field monitoring instrumentation available for accurately monitoring cesium and strontium, particularly in the presence of radioiodine. Radioiodine can be a potential contamination problem in liquid milk, whereas radiocesium and radiostrontium can be a contamination problem in processed milk products. Monitoring for the long half-life nuclides such as cesium and strontium requires sophisticated equipment or chemistry procedures which are only available in a laboratory. 2 references, 21 figures, 21 tables.

26066 **Low-pressure transient flow film boiling in vertically oriented rod bundles.** Loomis, G.G.; Shumway, R.W. (EG & G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415). *Nuclear Technology;* **63**: No. 1, 151-163(Oct 1983). Contract AC07-76ID01570.

Flow film boiling heat transfer data from Semiscale Mod-3 gravity feed reflood experiments have been compared to existing film boiling correlations. The existing film boiling correlations were found to be inadequate for calculating Semiscale rod bundle results in the low void fraction region. Therefore, a new correlation for flow film boiling was developed. The new correlation is applicable for boiling water with stainless steel electrically heated vertical rods for a pressure range from 127 to 390 kPa. The new correlation is sensitive to such parameters as the local void fraction, the wall temperature, the bulk vapor temperature, and the total mass flux.

26067 **Aging trends in nuclear power plants.** *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 76(Fal 1983).

By the year 2000, eight nuclear power plants that have the combined capacity to generate over 5000 MW of electricity will be approaching their design lifetime of 40 years. Concerned about the aging of nuclear power plants, the US NRC has been sponsoring aging studies, some of which are being conducted by the Oak Ridge National Laboratory. ORNL's program to study the aging problems of nuclear power plants is briefly summarized.

26068 **Observation of ionic sodium uranate precursors in a laser simulation of the conditions inside the bubble formed in an HCDA of an LMFBR.** Zanotelli, W.A.; Craven, S.M.; Hercules, D.M.; Miller, G.D.; Moddeman, W.E.; Novak, F. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). *Nuclear Science and Engineering;* **85**: No. 1, 17-25(Sep 1983).

The conditions inside the bubble formed in a hypothetical core disruptive accident (HCDA) of a liquid-metal fast breeder reactor have been simulated with a LAMMA 500 laser microprobe mass analyzer. Results for $Na_2U_2O_7$ show that negative diuranate and positive sodium uranate ions are produced. Higher laser powers favor greater fragmentation to U^+, $(UO)^+$, and $(UO_2)^+$. The Na_2O/UO_2 results indicate vapor phase reactions result in the formation of positive and negative sodium uranate ion intermediates. Positive hydrogen ions are observed in some spectra. Higher laser energies (higher HCDA temperatures) favor sodium uranate ion formation. These data support the view that sodium uranate ionic precursors are formed in the vapor phase, bubble, of a simulated HCDA reaction. A prior argon-ionexcited secondary ion mass spectroscopy investigation of Na_2O/UO_2 and $Na_2U_2O_7$ showed no sodium uranate species, only the formation of U^+, $(UO)^+$, and $(UO_2)^+$.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 25603

2501 Magnetic

26069 (LA-UR—84-1139) Superconducting magnetic energy storage for utility applications. Rogers, J.D. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 26p. (CONF-8403120—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011335.

From American Association for the Advancement of Science conference; Lubbock, TX, USA (27 Mar 1984).

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Energy stored in the magnetic field of large coils, maintained superconducting at liquid helium temperature to prevent energy loss, can be used for diurnal load leveling and for dynamic stabilization of power transmission systems. A 30 MJ superconducting magnetic energy storage (SMES) system has been placed in operation at the Bonneville Power Administration Tacoma Substation to damp oscillations on electric transmission lines in the Western Power System. The SMES system and its operation are presented.

2502 Compressed Gas

REFER ALSO TO CITATION(S) 26074

26070 Factors affecting storage of compressed air in solution mined salt cavities. Allen, R.D.; Doherty, T.J.; Thoms, R.L. (Pacific Northwest Laboratory, Richland, WA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 1992-1999(Aug 1982). (CONF-820814—). Contract AC06-76RL01830.

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

Geologic factors affecting a salt deposit's acceptability for compressed air energy storage include diameter, depth, thickness, mineralogy, strength, presence of gas, faulting, seismic susceptibility, caprock quality, and rate of dissolution by ground water. Assessment of a potential site involves analyzing existing information, seismic surveying, exploratory drilling, examining salt and caprock, geophysical logging, measuring in situ stress, and determining hydrologic impact. Geologic exploration at Huntorf, Federal Republic of Germany, is discussed. Criteria are presented for cavern design parameters, which include octahedral shear strength, excess lateral stress, depth to cavern top, lateral salt thickness, vertical salt thickness, span, and height-todiameter ratio. Cavern, borehole and surface monitoring methods are discussed.

2505 Flywheels

26071 Analysis of fixed-base flywheel systems for electric utility applications. Olszewski, M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 1981-1986(Aug 1982). (CONF-820814—). Contract W-7405-ENG-26.

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

The demand for electricity exhibits diurnal, weekly, and seasonal variations. Because of these variations utilities experience off-peak times when the baseload generation capacity is not fully utilized. In addition, they experience on-peak loads substantially in excess of baseload generation capability. The use of energy storage would allow the cheaper base load generation to be used in place of expensive oil-fired combustion turbine power for peaking applications. This study has concentrated on the very shortterm peaking spikes experienced by utilities. These spikes are characterized as having a duration of up to 2 hours and a load of 85 to 100% of the utility's peak demand. This represents about 4% of the total annual amount of energy generated by utilities but about 13% of the total fuel costs. The purpose of the study is to assess the potential role for flywheels as a utility storage option and establish research and development priorities for fixed-base flywheel systems.

2506 Thermal

26072 (BMFT-FB-T—83-239) Influence of convection on the distribution of temperature in hot water storage systems. Straub, J.; Staudt, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 152p. (In German). NTIS (US Sales Only), PC A08 MF/A01. Order Number DE84750921.

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A numerical method was developed calculating the time dependence of the temperature distribution in systems for hot water storage. From this temperature distribution the contents of energy in the storage system can be calculated. This calculation is the basis for the estimation of the economy of such systems. Based on experimental measurements and on observation of the convection in the storage the model was developed regarding acceptable physical conditions. The heat losses on all surfaces of the store and their consequences on the storage fluid are considered. In case of thermal instable situations the energy transport is caused by convection, in case of stable temperature gradients by conduction. The model can be used for long and short time storage systems of different geometries. It is valued for systems storaging the energy over a seasonal period and for stores in district heating systems or similar applications. For systems of convenient geometry and or reasonal insulting high grades of efficiency are obtained even for seasonal stores.

26073 (CONF-830974—, pp 240-245) **Review of testing at the University of Minnesota aquifer thermal energy storage field test facility (FTF), St. Paul, Minnesota.** Hoyer, M.C.; Walton, M. (Univ. of Minnesota, St. Paul). Sep 1983. NTIS, PC A13/MF A01. Contract AC06-76RL01830.

From Physical and chemical energy storage annual contractors' review meeting; Arlington, VA, USA (12 Sep 1983).

Test cycles were conducted during the year, following experiments to prevent recurrence of precipitate clogging of the well-screen in the heat storage well. A fixed-bed reactor that allows precipitation of carbonate from heated water prior to entering the injection storage well was added to the system and has operated successfully. Test Cycle I, encompassing about 5 days of injection and heat recovery and 13 days of heat storage, showed an aquifer thermal recovery factor of 0.60. Overall system energy recovery factor was 0.52. Mean temperature of injected water was 90°C; mean temperature of water withdrawn from storage was 39°C. Test cycles II, III and IV are being planned. Modeled chemical equilibrium and measured chemistry of aquifer waters are in close agreement.

26074 Thermal energy storage media for advanced compressed air energy storage systems. Marksberry, L. (Flui-Dyne Engineering Corporation, Minneapolis, Minnesota). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 4: 2000-2005(Aug 1982). (CONF-820814—).

From 17. Intersociety Energy Conversion Engineering conference; Los Angeles, CA, USA (8 Aug 1982).

Screening tests were performed to compare materials for Thermal Energy Storage (TES) pebble media in advanced Compressed Air Energy Storage (CAES) power plants. Measurements were made of the effects of thermal cycling and bed weight on deterioration of the pebbles. Four materials were tested: Denstone fir-

eclay, iron ore, basalt rock, and cast iron. Each was tested as a pebble bed 0.9m (3 ft) in diameter and 4.6m (15 ft) high. The beds were heated and cooled between 310K (100F) and 750K (900F), at rates that simulated plant conditions, over 100 times at four hours per cycle. The most significant result was the good performance of the basalt rock, which is also the lowest cost material by a large margin.

2509 Batteries

26075 (ANL—83-55, pp 19-39) **Advanced battery research.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The objective of the advanced battery research at ANL is to provide a technical basis for the development of high-performance, electrically rechargeable cells for use in electric-vehicle batteries. Most of this effort has been directed toward lithium-alloy/iron sulfide cells (Li-Al/FeS, Li-Al/FeS_2, and Li-Si/FeS_2), which have boron nitride felt or magnesium oxide separators and a molten-salt (typically LiCl-KCl) electrolyte. To maintain the electrolyte in a fully molten state, the cells are operated within a temperature range of 430-500°C. An increasing effort is being placed upon investigation of other exploratory cell systems, e.g., sodium/molten nitrate cells with a solid electrolyte. During the past year, the advanced battery research at ANL was conducted under the direction of two lead laboratories, Lawrence Berkeley National Laboratory (LBL) and Sandia National Laboratories (SNL). The work directed by LBL emphasized basic research and included investigations of lithium alloy/iron disulfide cells, sodium/molten nitrate cells with solid beta alumina electrolyte, and glasses that exhibit fast sodium ion conduction and are, therefore, potential solid electrolyte materials. The portion of the program directed by SNL was concerned with Li-Al/FeS cells, and it involved cell development work in addition to testing and post-test examinations of the cells by ANL. The lifetime and performance goals for lithium-alloy/iron sulfide cells remain unchanged from last year's. The performance and lifetimes of present Li-Al/FeS cells are approaching the 1983 goals. Recent full-size cells fabricated at ANL have achieved a specific energy of 101 Wh/kg and a volumetric energy density of 284 Wh/L at 3.4-h discharge rate, as well as a peak specific power of 132 W/kg at 50% state of charge. Two groups of 12 cells have shown mean times to failure of 345 and 330 cycles, respectively.

26076 (ANL—83-55, pp 40-55) **Industrial electrochemical projects.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

This program provides management of industrial contracts for development of aqueous battery technology for electric-vehicle and load-leveling applications, operates the National Battery Test Laboratory (NBTL), provides support research for aqueous battery development, and investigates new energy-conserving techniques that may be applicable to industrial electrolytic processes. These activities are discussed.

26077 **(BMFT-FB-W—83-030) Nickel cadmium cell SD 15 K, qualification and operation of a modularized battery 50 Ah, 100 V.** Koethe, H.K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 163p. (In German). NTIS (US Sales Only), PC A08 MF/A01. Order Number DE84750929.

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The work successfuly performed under Contract DFVLR-BPT 01 TO 016 A - V WRT 20/5 "Nickel Cadmium Akkumulatorzelle SD 15 K" had two goals: 1. The acknowledgement of the qualification of the hermetically sealed Nickel Cadmium Cells for space projects and 2. The development of a concept for construction and operation of a modularized pattery employing this accumulators, to be able to be boosted up to 50 amperchours capacity and 100 volts main bus voltage. For the accumulator SD 15 K a complete set of qualification documents in accordance with GfW Vorschrift 013, Edition 1 (1978), Table 1, has been elaborated. For customers there is available a "Performance Specification LS - SD 15 K - GfW 8/78" as well as an "Abbreviated Report on Qualification Doc. 3.18" written in English. The techniques developed for construction and operation of a modularized battery became the basis of the development contract DFVLR-BPT 01 tO 047 B - AK/RT - WRT 2076 "Charging Method and Electronic Components for the Modularized 50 Ah Battery (SD 15 K)".

26078 **(BNL—34479) Effect of charging methods on battery electrodes.** McBreen, J. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 9p. (CONF-831086—13). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010287.

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

This paper reviews the effect of modified charging methods on the structure and behavior of several battery electrodes. These include the alkaline cadmium, zinc, silver oxide and nickel oxide electrodes. Also included are recent results obtained for pasted zinc electrodes and in acidic zinc chloride electrolytes. Modified charging methods can greatly affect electrodes perticularly when the charging reaction involving the nucleation, and growth of a new phase. Many of the observed morphological effects can be a described to nucleation and orientation effects.

26079 **(CONF-8403116—1) Advanced battery development in the US.** Shimotake, H.; Nelson, P.A. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010505.

From Government Industrial Research Institute seminar; Osaka, Japan (23 Mar 1984).

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Batteries for load-leveling and electric-vehicle applications are under development in the United States. The most difficult requirements for these applications are long cycle life, high power density, and low cost. Steady progress is being made in developing advanced batteries. The US Department of Energy is sponsoring development of sodium-sulfur, zinc-bromine, zinc-chloride, and aluminum-air batteries. Exploratory research is being conducted on a variety of cell systems, such as lithium-metal sulfide, alkali metal-sulfur, glass electrolyte, and low-temperature organic electrolyte. This paper reviews the US government effort in the development of advanced batteries and discusses some of the key systems.

26080 **(DOE/ET/29123—T1) Simulation-based energy storage evaluation methods. Executive summary.** Lee, S.T.; Peschon, J. (Systems Control, Inc., Palo Alto, CA (USA). Energy Systems Div.). Jun 1980. Contract AC01-77ET29123. 70p. NTIS, PC A04; 3; GPO Dep. Order Number DE84011277.

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The objective of this study was to develop models for optimizing the operation of a power system containing storage devices and to develop models for optimizing future power systems with respect to the characteristics of the storage devices that they may contain. This addresses the problem of optimum expansion planning.

26081 (LBL—13500, pp 1.48-1.49) **Applied battery and electrochemical research program.** Cairns, E.J.; McLarnon, F.R. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

General problem areas addressed by the program described include identification of new electrochemical couples for advanced batteries, determination of technical feasibility of new couples, improvements in battery components, and establishment of engineering principles applicable to batteries and electrochemical processes. Major emphasis is given to applied research which will lead to superior performance and lower life-cycle costs. Progress is reported in the areas of exploratory battery research and development, engineering-science research, and materials research. (LEW)

26082 (LBL—13500, pp 1.50-1.52) **Battery electrode studies.** Cairns, E.J.; McLarnon, F.R.; Katz, M.; Miller, K.; Nichols, J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The purpose of this research is to study the behavior of electrodes used in secondary batteries and to investigate practical means for improving their performance and lifetime. Systems of current interest include ambient-temperature rechargeable cells with zinc electrodes (Zn/NiOOH, Zn/AgO, Zn/Cl_2, Zn/Br_2, Zn/Air, and Zn/$Fe(CN)_6$, and rechargeable molten salt cells (Li-Al/FeS, Li-Al/FeS_2, Li-Si/FeS, Li-Si/FeS_2, and Na/β''-Al_2O_3/NaCl-$AlCl_3$-SCl_4). The approach used in this investigation is to study the life- and performance-limiting phenomena under realistic cell operating conditions. Investigations have centered on the zinc electrode, which exhibits satisfactory performance in rechargeable alkaline cells (Zn/NiOOH, Zn/AgO) but has an inadequate cycle life. The short lifetime and continual capacity loss of the zinc electrode are closely related to a phenomenon known as shape charge, the redistribution of active material over the face of the electrode as the cell is cycled.

26083 **(SAND—84-0685C) Zinc/bromine batteries: a status review.** Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1984. Contract AC04-76DP00789. 16p. (CONF-8311134—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008973.

From EPRI workshop on the electrochemistry of zinc/halogen batteries; Palo Alto, CA, USA (30 Nov 1983).

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The intent of this report has been to show that significant programs are underway to develop the zinc/bromine couple into a useful battery system. This report summarizes three zinc/bromine development programs. The developers are Exxon Research and Engineering Company (Linden, New Jersey), Energy Research Corporation (Danbury, Connecticut) and Gel Incorporated (Durham, North Carolina). (CS)

26084 **(UCID—20061) Development of hydrocyclones for aluminum/air battery applications.** Newman, M. (Lawrence Livermore National Lab., CA (USA)). 16 Apr 1984. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011403.

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An aluminum air battery consists of three main components: a galvanic cell stack fueled by aluminum and water, a crystallizer (a fluidized bed), and a hydro-cyclone, to separate electrolyte from aluminum trihydroxide. The crystallizer stabilizes the electrolyte by extracting excess aluminum trihydroxide. A separator (the hydrocyclone) is necessary to divert heavy particles to the crystallizer while recycling fine particles to the cells. A hydrocyclone suited to this application was developed based on the design of a commercially available unit, the PC-1, manufactured by Krebs Engineers of Menlo Park. Information supplied by Krebs indicated that we could achieve a cut point of 15 micrometers. At time intervals of 120, 240 and 360 minutes of testing the particle size cut point remained constant at 20.2-25.4 micrometers. The separation coefficient was .47, .48 and .51, respectively. The discrepancy between the actual and the anticipated results is most likely due to variance from suggested sizing and the use of a tangental feed instead of the involuted feed of the Krebs design.

26085 **(UCRL—15580) Aluminum-air battery development. Final report, June 17, 1982-March 17, 1983.** Levy, D.J.; Hollandsworth, R.P. (Lockheed Palo Alto Research Labs., CA (USA)). 18 Apr 1983. Contract W-7405-ENG-48. 70p. (LMSC-D—913918). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011067.

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A rapidly-refuelable, six-cell Al-air battery of the MI-1 moving anode design (norminal 200-cm^2 electrodes) was assembled from stackable bicells. RX-808 aluminum anodes and air cathodes were used with a recirculated alkaline electrolyte. Battery performance was determined as a function of temperature (47-64°C), electrolyte flow (200-500 Re) and sodium aluminate concentration (1.0-2.6M). Peak power was found to be proportional to temperature, inversely proportional to aluminate concentration and independent of electrolyte flow. The best performance was a peak power density of 5.28 kW/m^2 (cathode area) at 5.52V and 64°C. Under other conditions, energy density averaged 2.08 kWh/kg Al and coulombic efficiency was 80%. Cells are easily refueled in a few minutes by use of a removable cap. A new anode plate is inserted behind the thin old plate and 100% utilization is achieved. Anodic polarization is relatively low and cell performance is primarily limited by the amount of active cathode area. Air cathodes with 10% CoTMPP performed at least as well if not better than cathodes with 1.2 mg Pt/cm^2. A thermal balance of the battery determined the magnitude of heat sources and cooling requirements under several operating conditions. A method for real time monitoring of aluminate concentration, based on measurement of temperature and conductivity, was evaluated. The feasibility of corrosion-protective edge and back coatings on anodes to increase coulombic efficiency was also examined.

26086 **Hermetically sealed electrical feedthrough for high temperature secondary cells.** Knoedler, R.; Nelson, P.A.; Shimotake, H.; Battles, J.E. (to Dept. of Energy). US Patent Application 6-517,473. 26 Jul 1983. 14p. Contract W-31-109-ENG-38.

A passthrough seal is disclosed for electrically isolating the terminal in a lithium/metal sulfide cell from the structural cell housing. The seal has spaced upper and lower insulator rings fitted snuggly between the terminal and an annularly disposed upstanding wall, and outwardly of a powdered insulator also confined between the upstanding wall and terminal. The adjacent surfaces of the upper insulator ring and the respective upstanding wall and terminal are conically tapered, diverging in the axial direction away from the cell interior, and a sealing ring is located between each pair of the adjacent surfaces. The components are sized so that upon appropriate movement of the upper insulator ring toward the lower insulator ring the powdered insulator and sealing rings are each compressed to a high degree. This compacts the powdered insulator thereby rendering the same highly impervious and moreover fuses the sealing rings to and between the adjacent surfaces. The upper and lower insulator rings might be formed of beryllium oxide and/or alumina, the powdered insulator might be formed of boron nitride, and the sealing rings might be formed of aluminum.

26087 **Degradation of sodium β''-alumina: effect of microstructure.** Buechele, A.C.; De Jonghe, L.C.; Hitchcock, D. (Lawrence Berkeley Lab., CA). *Journal of the Electrochemical Society;* **130**: No. 5, 1043-1049(May 1983).

The effect of microstructure on failure initiation of sodium beta''-alumina solid electrolytes has been investigated by acoustic emission detection. Mode I failure initiation follows Weibull statistics with a modulus of about 2.5. The observed average critical current densities were 145 and 640 mA/cm^{-2} for large and for small grained electrolytes, respectively. Nonuniform secondary current distributions near the electrode edges were considered and were found to lead to minor corrections to these values. The conditions under which nonuniformity of current would affect failure statistics are considered. Considerations of failure statistics indicate conditions where proof testing may be necessary to achieve sufficient reliability. These considerations assume complete equivalence between mechanical and electrolytic failure; the indication is, however, that such equivalence is not valid.

29 ENERGY PLANNING AND POLICY

26088 **(DOE/EIA—0149(83)) EIA Publications Directory 1983: a user's guide.** (National Energy Information Center, Washington, DC (USA)). Mar 1984. 158 p. NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. Order Number DE84010157.

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This issue contains abstracts of publications released for printing in 1983. A cumulative Directory which abstracts all EIA publications issued from October 1977 to December 1981 is also available from the National Energy Information Center. The directory includes a subject index, a title index, and a report number list-

ing for all 1983 EIA publications as well as complete information on how to order these publications. The abstracts of the publications are arranged by broad subject categories such as Coal, Petroleum, Natural Gas, and Energy Planning and Policy. These subject categories are further divided into subcategories. For example, the petroleum category is subdivided into reserves, drilling and production, processing petroleum products, and marketing and economics.

26089 **(N—8411578) Energy: A continuing bibliography with indexes, issue 38.** (National Aeronautics and Space Administration, Washington, DC (USA)). Jul 1983. 348p. (NASA-SP—7043(38)). NTIS, PC $15.00.

This bibliography lists 1367 reports, articles and other documents introduced into the NASA scientific and technical information system from April 1, 1983 through June 30, 1983.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 25313, 25317, 25319, 25603, 26149, 26196

26090 **(DOE/EI/11702—T1) State utilization of energy information resources: final report.** (Massachusetts Office of Energy Resources, Boston (USA)). Sep 1981. Contract FG01-80EI11702. 30p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010866.

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The State Energy Office's responsibility for more detailed and timely State-level energy data has grown as a result of increasing legislative and analytic requirements. Each office will have a number of different requirements for the types of data necessary for analysis purposes depending on fuel mix, supply availability and the State's economy. This report details the requirements and needs of one State, Massachusetts, and should serve as a guide for other States and the Department of Energy in assessing State level data required for policy analysis efforts. It also provides a description of available State level data problems associated with that data. Fuel mix included: distillates, residual fuels, gasoline, fuel oils, cool, natural gas, hydroelectric power and nuclear power. 6 tables.

26091 **(DOE/ET/29365—6) Underfrequency load shedding.** (Purdue Univ., Lafayette, IN (USA)). Mar 1983. Contract AC01-79ET29365. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010589.

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Underfrequency load shedding, which usually follows separation of a power system into islands, is an emergency control means designed to suppress further decay of system integrity. The purpose of this study is to formulate and analyze the problem of underfrequency load shedding, with special regard to stability, robustness, and coordination between different control areas within an island. This treatment complements and broadens studies of a simple first order model of frequency dynamics.

26092 **(DOE/RA/50154—T1) Optimal scheduling of complex industrial processes.** (Institut National de Recherche d'Informatiqueet d'Automatique (INRIA). Domaine de Voluceau, 78 - Rocquencourt (France)). 1984. Contract AC01-80RA50154. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009738.

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Investigated in this project are some methods which are particularly useful for treating large systems. They are mostly considered in the context of energy systems and networks (water, electricity networks, flexible manufacturing systems). The following methods were investigated: (1) deterministic systems; (2) stochastic systems; (3) systems controlled by impulses; and (4) development of CAD systems adapted to large systems.

26093 **(DOE/RG/10407—T1) PURPA grant award. Initial and final report, October 1, 1980-December 31, 1981.** Eliopulos, A.J. (Wyoming Public Service Commission, Cheyenne (USA)). Mar 1982. Contract FG01-80RG10407. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008888.

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This is the FIRST and also the FINAL report of the Wyoming Public Service Commission (hereinafter referred to as the Wyo. PSC) providing a summary of activities and results achieved during the entire period from October 1, 1980 to end December 31, 1981. The Wyoming Commission used the grant funds for required PURPA compliance to the December 31, 1981 closing date of this report and for establishing criteria and procedures for continuing future PURPA compliance. The regulated Wyoming utilities remain at 12 private owned utilities, 23 rural electric cooperative utilities, 2 very small electric cooperatives, and 12 municipal electric utilities (insofar as they operate outside their corporate limits). All PURPA covered utilities in Wyoming were regulated for the grant term by the Wyo. PSC and remain at four private electrics, one rural electric cooperative, and four private gas utilities.

26094 **(E/ECE—1063) Energy transition in the ECE region.** (United Nations, New York (USA)). 1983. 166p. United Nations, New York, NY.

The report examines the new energy policies within the United Nations Economic Commission for Europe (ECE) which have arisen out of the energy crisis of the early 1970s. It has been generally accepted that an 'energy transition' to renewable sources should be the ultimate objective. Specific objectives which have been pursued and developments as of 1982 are discussed under the general areas of energy efficiency and economy; oil substitution; indigenous energy production; trade sources and diversification; and new technologies. Environmental aspects, conservation and international cooperation are discussed.

26095 **(EUR—8800-EN) Reference case 2 UK.** Hughes, C. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1983. 30p. Commission of the European Communities, Luxembourg.

In December 1982 a second case study was undertaken using the medium term energy modelling system Eureca-Explor-EDM. Section 1 of this report summarises the underlying assumptions on which the Reference Case II is based together with the results obtained. In Section 2 these aspects are treated in more detail and a comparison of the results with those of other national forecasts is made.

26096 **(EUR—8809-EN) Energy models for Denmark.** Morthorst, P.E. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1983. 33p. Commission of the European Communities, Luxembourg.

This is the final report covering the work done under contract no. EM2-070-DK(G). It contains the results and evaluations of two case studies worked out with the EC-medium-term complex of energy models. The case studies are prepared in a collaboration between the EC-Commission and the national implementation teams. The two case-studies are defined in a substantial different way: 1) high economic growth; high rise in energy prices in real terms; 2) low economic growth; constant energy prices in real terms. To understand the methodology behind the forecasts, the models applied are briefly described in chapter II. The results of the two case-studies are shown and evaluated in chapter III and IV. A comparison between the two case-studies is made in chapter V. Finally, a comparison is made to existing national forecasts in chapter VI.

26097 (LBL—13500, pp 5.20-5.22) **California energy systems assessment models.** Sathaye, J.A.; Ruderman, H.; Chan, P.T.; Schmidt, H. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

An overview is presented of the California Energy Planning Model. Energy scenarios specifying the primary energy from each type of fuel are the basic input for the chain of models: an Energy Planning Model and a California Input-Output Model. The scenarios specify the amount of energy supplied by oil, gas, coal, nuclear, solar, wind, ocean, and biomass facilities that is needed to fulfill the demand in the end-use sectors. Different end-use demands will

affect the economy and the environment differently, depending on the investment in each end use.

26098 (LBL—13500, pp 5.22-5.25) **Mineral requirements for energy scenarios.** Sathaye, J.A.; Ruderman, H. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The analysis described in this report estimated and evaluated the materials and raw and processed minerals that would be demanded by energy development through the year 2000 under four national energy scenarios formulated by the Department of Energy (DOE). We examine the demand for minerals selected for their potential strategic importance in future energy development. Specific minerals which may be viewed as strategic and critical to US energy development in light of their domestic and worldwide availability were identified. A more detailed discussion of the methods and results of this study may be found in another report.

26099 (LBL—13500, pp 5.25-5.27) **Residential end-use demand modeling: improvments to the ORNL model.** McMahon, J.E. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Three major changes to the methodology were undertaken. First, the approach to changes in efficiency of new appliances was improved. Second, methods of constructing new homes involve higher levels of insulation than in the past and should exhibit significant effects on energy consumed for space conditioning (heating and cooling). Third, the expected sales of appliances will depend not only on the number in stock but also on the age distribution of existing units. A vintaging approach, in which the age distribution is updated each year, provides a better guide for future replacement sales. All three modifications replace simpler assumptions with a more complex set, and all three impose additional data requirements on the model.

26100 (LBL—13500, pp 5.29-5.32) **Residential hourly and peak-demand model.** Verzhbinsky, G.; Levine, M.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

A model was developed that simulates the hourly residential electricity demand for electric utility service areas. This model is integrated with the Oak Ridge National Laboratory (ORNL)/Lawrence Berkeley Laboratory (LBL) residential energy demand forecasting model. The most important new feature of the hourly demand model is that it is disaggregated to 12 end uses. This disaggregation, in addition to its extensive time of use and engineering/econometric data base, makes possible the evaluation of specific electric utility conservation programs and various energy conservation policies.

26101 (USGS-OFR—83-356) **Geologic assessment of the fossil energy and geothermal potential of the Sudan.** Setlow, L.W. (Geological Survey, Reston, VA (USA)). 1983. 61p. USGS-OFS-Box 24524-Denver Federal Center, Denver, CO 80225.

This preliminary report provides geological input to the consideration of appropriate activities that can enhance the exploration and development of fossil-fuel and possible geothermal energy resources of the Sudan, and is based on study of available literature in early 1982. 59 references, 16 figures, 7 tables.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 25316, 25336, 26125, 26146, 26216, 27087, 27089

26102 (CONF-8208183—) **Report of the Energy Field Institute V on western energy opportunities, problems, and policy issues.** Hepworth, J.C.; Foss, M.M. (Colorado School of Mines, Golden (USA)). Dec 1982. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010342.

From 5. Energy and Minerals Field Institute meeting; Casper, WY, USA (15 Aug 1982).

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The fifth Energy and Minerals Field Institute program for Washington, D.C. Congressional and Executive Aides was held during August 15-21, 1982. The five-and-one-half day program was conducted through Wyoming, Colorado and Utah and consisted of visits to: an R and D tertiary petroleum production facility; an historic oil field entering secondary production; a surface uranium mine; a petroleum exploration drilling rig; a surface coal mine; an air cooled, coal-fired power plant; an oil shale site; a geothermal-electrical generating facility; and open pit copper mine and associated smelter and refinery; a petroleum refinery and an oil shale semi-works retort. During the field program, participants had opportunities to view communities affected by these activities, such as Wright City and Gillette, Wyoming, Parachute, Colorado and Milford and Cedar City, Utah. Throughout the program, aides met with local, state and industry officials and citizen leaders during bus rides, meals and site visits.

26103 (DOE/CS/20448—T4) **Activities of the Energy Development Board of Mercer County.** (Resource Planning Associates, Inc., Washington, DC (USA)). Jul 1979. Contract AC01-78CS20448. 53p. NTIS, PC A04; 1; GPO Dep. Order Number DE84010740.

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Activities relative to demographic changes coming to the county from increased coal production and synthetic fuel production are reviewed as follows: organizing, planning, and financing. Energy Development Board minutes and pertinent local newspaper articles for the period are included. (MHR)

26104 (DOE/CS/20448—T5) **Activities of the Energy Development Board of Mercer County.** (Resource Planning Associates, Inc., Washington, DC (USA)). Nov 1979. Contract AC01-78CS20448. 46p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010738.

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Activities relative to demographic changes coming to the county from increased coal production and synthetic fuel production are reviewed as follows: organizing, planning, financing, improving land and installing public facilities, and providing housing and commercial facilities. Energy Development Board minutes and pertinent newspaper articles for the period are included. (MHR)

26105 (DOE/CS/20448—T6) **Activities of the Energy Development Board of Mercer County.** (Mercer County Energy Development Board, Hazen, ND (USA)). Oct 1979. Contract AC01-78CS20448. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010732.

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Activities relative to demographic changes coming to the county from increased coal production and synthetic fuel production are reviewed as follows: organizing, planning, financing, improving land and installing public facilities, and providing housing and commercial facilities. Energy Development Board minutes and pertinent newspaper articles for the period are included. (MHR)

26106 (DOE/CS/20448—T7) **Activities of the Energy Development Board of Mercer County.** (Resource Planning Associates, Inc., Washington, DC (USA)). May 1979. Contract AC01-78CS20448. 56p. NTIS, PC A04; 3; GPO Dep. Order Number DE84010733.

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Activities relative to the demographic changes coming to the county from increased coal production and building a plant for synthetic fuel production are reviewed as follows: organizing, planning, financing, and improving land and installing public facilities. Energy Development Board minutes and pertinent newspaper articles are included. (MHR)

26107 **(DOE/EI/10667—T2) Macroeconomic impacts of energy shocks: an overview.** (Stanford Univ., CA (USA). Energy Modeling Forum). 23 Mar 1984. Contract FG01-80EI10667. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010296.

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Through a comparison of existing models of the US economy, this study evaluates the likely short- to medium-term effects of energy price changes on inflation, unemployment, and economic growth. It focuses on the impacts during the four years immediately following the energy price change. During this period, the economy's adjustment may still be unfolding and not yet complete. The working group studied 10 scenarios simulated by 14 participating modelers. We identified several prominent conclusions relating to the impacts of a shock, the efficacy of different economic policies, energy policy considerations, and key characteristics of the participating models.

26108 **(DOE/ET/60004—T3) Calculating the cost of producing energy for regulated and nonregulated industry.** Clark, C.E. Jr.; Fancher, R.B.; Nesbitt, D.M.; Regulinski, S.G. . (Decision Focus, Inc., Los Altos, CA (USA)). Aug 1980. Contract AC05-79ET60004. 173p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011237.

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There are several motives for this report. The first is to help the reader understand how the cost of energy is affected by its many constituent elements. The correct calculation of energy cost is best accomplished by working only with observable elements such as current-dollar capital costs, tax rates, inflation indexes, and public utility regulations. Quantities that cannot be observed, such as constant-dollar costs, are either converted to observable quantities or not used in the calculations. The effects of taxation and regulation will be observable quantities as computed in current dollars. A second motive for this report is to develop a standard format for describing the cost of producing energy from a specific technology. The format developed here is not only based on observable quantities but it is flexible in that it can adapt to changes in cost elements and revisions of tax and regulatory provisions. The end result of this paper - the formulas for calculating the levelized cost of producing energy - provides a convenient and intuitive method for communicating information about technologies and the effects of inflation, taxation, regulation, and other variables on the cost of energy.

26109 **(DOE/PE/06419—T1) Alternative work schedules energy conservation potential. Task IV report.** (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). 30 Dec 1980. Contract AC01-78PE06419. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84006091.

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An evaluation of the potential economic impacts of flexitime, compressed workweek and permanent part-time work schedules is presented. In three major sections: an economic impact assessment at the establishment level based on case studies of nine firms using alternative work scheudles; an economic impact assessment at the all industry level; and a discussion of certain studies of transportation related economic impacts, including a study of staggered hours and compressed work weeks conducted under the auspices of Rensselaer Polytechnic Institute, the New York State Department of Transportation, and the Federal Highway Administration and a study of staggered hours schedules conducted in Philadelphia by the Delaware Valley Regional Planning Council, the Philadelphia Chamber of Commerce, and the Southeastern Pennsylvania Transit Authority. A final section summarizes findings, comparing and merging, where possible, the conclusions of the previous sections.

26110 **(DOE/PE/06419—T2) Alternative work schedules energy conservation potential. Task V report. Executive summary and implementation.** (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). 3 Mar 1981. Contract AC01-78PE06419. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006092.

The Task V effort of this comprehensive study of the energy conservation potential of alternative work schedules combines the results of preceding tasks to determine which alternative work schedules have energy conservation potential and are economically feasible. The primary sources of the conclusions presented here were the Task III report, which was based on case studies and transportation and building energy consumption models that calculated the energy impacts of each type of alternative work scheudle, and the Task IV report, which was based on studies and a literature review and analysis by a leading AWS researcher to assess the economic impacts of each schedule (flexitime, part-time permanent, and compressed workweek). Implementation procedures for the work schedules expected to reduce energy consumption. Topics covered include legislative and regulatory considerations, public relations activities, and the need for coordination with local authorities such as mass transit operators and Chamber of Commerce. Emphasis is placed on the different implementation procedures required under ormal and energy emergency conditions. Conclusions point to economic feasibility but do not offer realistic potential as an energy conservation technique.

26111 **(DOE/PE/06419—T3) Alternative work schedules energy conservation potential. Task III report.** (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA); Peat, Marwick, Mitchell and Co., Washington, DC (USA)). 21 Nov 1980. Contract AC01-78PE06419. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84006087.

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Model analysis and case studies for flexitime, part-time permanent, and compressed workweek showed workers switching to more energy-efficient transportation modes and decreases in work travel time but results may have been motivated by energy shortages and price increases rather than the work schedule changes. Therefore, implementation of the schedule changes on a nationwide scale would have very small increases in workplace energy consumption which would likely be offset by a small decrease in transportation energy consumption. (PSB)

26112 **(DOE/PE/06419—T5) Alternative work schedules energy conservation potential. Task 1 report.** (Peat, Marwick, Mitchell and Co., Washington, DC (USA); Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). 1979. Contract AC01-78PE06419. 168p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE84006086.

Current alternative work schedule history and experiences are discussed with particular emphasis on major factors which affect the adoption and use of alternative work schedules. In addition to researching the literature, a number of local government organizations, which are experimenting with alternative work schedules, have been contacted to obtain data on their experiences. This information has been included in the report. An extensive bibliography has been included in this report as Appendix A. It has been partitioned into general subject areas to facilitate its use. Appendix A serves two purposes, it contains the bibliographic references made in the body of the report, and it contains an extensive list of general references concerning the subject of Alternative Work Schedules. Therefore, Appendix A could be used as a separate comprehensive bibliography on Alternative Work Schedules. Appendix B discusses the various people and organizations contacted to acquire desired information for the study.

26113 (LBL—13500, pp 5.38-5.41) **Determinants of residential energy use.** Craig, P.P.; Cramer, J.C.; Dietz, T.M.; Hackett, B.; Kowalczyk, D.J.; Levine, M.D.; Vine, E.L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Residential energy consumption is being studied in the cities of Davis and Lodi, California. Data from this project are being used as input to the DOE-2,1 energy-use model to validate the model's energy-use estimates for residential buildings. The project data will allow validation checks for projections of hourly and weekly electricity use and for annual and monthly electricity and gas use. A second goal of this investigation is the construction of a multiple regression model that combines physical characteristics of a residence with appliance information, occupant behavioral information, occupant attitudes, demographics, and weather variables for explaining the variation in monthly energy use. A third and

final goal of this project is the evaluation of utility-sponsored and locally run community electricity management programs in Davis and Lodi through the use of survey results and the analysis of actual billing data.

26114 **(NMERDI—2-71-4136) Methods for assessing economic returns from state-supported energy research. Final report.** Cummings, R.G. (New Mexico Univ., Albuquerque (USA). Dept. of Economics). Jan 1984. 135p. NMERDI, Information Center-University of New Mexico, Suite M, 457 Washington, SE, Albuquerque, NM 87108.

This study develops two analytical methods for assessing economic impacts associated with expansions in New Mexico's energy industries. These analytical tools are intended to serve NMERDI's needs for such assessments in their program planning activities as well as in their assessments of research and development proposals. The first method consists of an Input-Output Matrix, from which gross output, income and employment multipliers are derived. These multipliers allow for order-of-magnitude estimates of economic impacts associated with expansions in particular industries; interindustry comparisons are limited by differentials in the quality of data presently available for different industries. The second method consists of rule of thumb, Energy Man Vectors which allow for rough estimates of impacts from energy sector expansions on employment, income, state tax receipts, water use and economy-wide effects.

26115 **(NP—4770231) Resource-extracting firm with set-up costs.** Siebert, H. (Mannheim Univ. (Germany, F.R.). Sonderforschungsbereich 5 - Staatliche Allokationspolitik im Marktwirtschaftlichen System). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770231.

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A mining firm typically chooses an optimal time profile of extraction and an optimal initial investment. Both problems are interrelated: extraction costs depend on the initial capital stock of the mine, and we can expect economies of scale in extraction over some range of extraction levels. In this paper is analysed how set-up costs influence the time pattern of extraction and which rule governs the optimal size of investment. In Section 1, the problem is defined and the assumptions are specified. For a given capacity, the optimality conditions are derived in Section 2. The rule with respect to optimal investment and the transversality conditions are discussed in Section 3. The results are illustrated diagrammatically (Section 4). Finally, the time profile of extraction is analysed when demand behavior is explicitly introduced.

26116 **(NP—4900963) Guide to state energy assistance offices.** (American Association of Retired Persons, Washington, DC). 1984. 65p. NTIS, PC A04/MF A01. Order Number DE84900963.

In 1984 federal, state and local government agencies will once again administer programs to provide energy assistance funds and information to eligible families who may need assistance in paying their fuel bills or in weatherizing their homes. This 61-page booklet is a state-by-state listing of low income energy assistance, aging, community block grant, weatherization assistance, state energy director and conservation contracts. To help individuals determine which program would be most helpful to them, a summary of the eligibility requirements and/or services offered for each program is given.

26117 **(PNL-SA—11979) Economic valuation of acid deposition induced changes in the productivity of commercial forests.** Callaway, J.M. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 10p. (CONF-840269—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010701.

From NAPAP Task Group G peer review meeting; Burlington, VT, USA (14 Feb 1984).

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Several recent studies have reported localized decreases in the growth of several commercially important forest species in the northeast United States. These observed reductions in basal area growth may be related to increases in acid deposition and other man-made pollutants over the last two or three decades. If this is the case, then increases in region-wide levels of acid deposition may have effects on the biomass content and age-species composition of the regional timber inventory. These physical changes can influence regional stumpage prices and harvest levels through changes in the marginal cost of harvesting timber as a product and through changes in the opportunity cost of holding timber as an asset. Resultant changes in the profits earned by timber owners and the buyers of stumpage can be used to attach monetary value to the effects of acid deposition on the timber resource base. The objective of this study is to develop a capability to value acid deposition-induced changes in the productivity of commercial timberland in the northeast United States. Simulations will be conducted to determine the effects of acid deposition-induced changes in species growth rates on the profits earned by timber owners and buyers in relevant stumpage markets. The sensitivity of these results to different rates of return to private owners, alternative management practices, and to the levels of exogenous variables which influence the demand for stumpage will be assessed. 8 references.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 25325, 25343, 26094, 26117, 26132, 26930, 26973, 26991, 27043, 27046, 27047, 27063, 27086, 27087, 27088, 27091, 27094, 27095, 27178

26118 (CONF-811048—Summs., pp 3p, Paper 97) **Control strategies to protect indoor air quality.** Howlett, C.T. Jr. (Georgia-Pacific Corp., Atlanta). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Implementation of an indoor air quality program will involve a complex interrelationship between federal and state agencies and industry standard setting organizations. At the federal level, EPA has more experience in establishing ambient levels, but product performance standards will involve HUD, DOE, and CPSC. State and local building code agencies have traditionally regulated home construction. Adding another regulatory layer should be approached cautiously. While jurisdictional responsibilities evolve, market forces have resulted in a workable program to address the formaldehyde issue and will be an important element in addressing the control of other indoor pollutants. (DT)

26119 **(CONF-8105249—Summ.) Energy independence: consequences for human health. Final report.** (American Association for the Advancement of Science, Washington, DC. Office of Public Sector Programs). 10 Dec 1981. Contract FG01-78ET21040. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009741.

From AAAS regional energy seminar - energy independence: consequences for human health; Berkeley, CA, USA (28 May 1981).

The second 1981 regional energy seminar, Energy Independence: Consequences for Human Health, was held on May 28 and 29 on the campus of the University of California, Berkeley. The seminar's objectives were twofold: (1) to introduce the latest scientific findings into energy and health-related policy-making and planning, and (2) to provide an opportunity for exchange of information among the energy policy decision-makers, the human health care and delivery communities, and scientists and technologists from related fields.

26120 **(DOE/ET/29212—T1) Preliminary study of the behavioral and biological effects of high intensity 60 Hz electric fields. Final report.** Feldstone, C.S.; Polonis, J.J.; Smith, H.D.; Gibson, E.G.; Spiegel, R.J.; Tarver, W.B.; Smith, R.T.; Barsun, H.F.; Winters, W.D. (Southwest Research Inst., San Antonio, TX (USA)). Jan 1981. Contract AC01-78ET29212. 652p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84001244.

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In response to concern over potential effects of high strength electric fields on living organisms, Southwest Research Institute (SwRI) has completed a preliminary research program

(Phase 1) to develop techniques for conducting a major study (Phase 2) of the behavioral and biological effects of high strength 60 Hz electric fields on baboons. The result of the study should be either a clear indication that the highest field strength of practical interest (analogous to the highest strength that can be encountered by man under power lines) produces no deleterious effects or an indication of the lowest electric field strength which produces deleterious effects in the baboon. The generalization of results to man will be further aided by the development of models relating the physical effects of electric fields on man to the physical effects of electric fields on the baboon.

26121 (LBL—13500, pp 3.30-3.33) **Indoor air quality in new energy-efficient houses and retrofitted houses.** Hollowell, C.D.; Berk, J.V.; Brown, S.R.; Dillworth, J.F.; Koonce, J.F. Jr.; Pepper, H.H.; Young, R.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

In general, studies of new energy-efficient residences (with air-exchange rates lower than 0.4 ach) indicate that indoor levels of radon, formaldehyde, and particulates sometimes exceed existing guidelines or standards for outdoor air, due to a number of factors such as geographic variation of radon content in soil, indoor furnishings, and occupant activities. The impact of residential retrofit programs on indoor air quality appears to be minimal, based on this study of three retrofitted houses, where no pollutants reached levels approaching health guide-lines or standards. We can conclude that retrofit programs, such as that of Pacific Power and Light Company, improve the thermal integrity of houses and should continue without fear of significantly increasing indoor air pollution. In the Cranbury house, the super retrofit had no appreciable effect on the infiltration rate already achieved by the homeowner's prior weatherization, and thus little or no adverse impact on indoor air quality resulted from this super retrofit.

26122 (LBL—13500, pp 5.2-5.5) **Coastal zone assessment program.** Ritschard, R.L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Activities included an ecological assessment of fossil-fuel-based technologies and an environmental analysis of marine biomass (both reported elsewhere in this report) in addition to the accomplishments listed here. Coastal zone management programmatic changes that relate to energy at both federal and state levels were examined. It was anticipated that the differences in impact and response between states and regions would be identified as determined by the varying levels of coastal energy activity, their degree of participation in various programs, the state of development or implementation of various coastal plans, and the expected response to program changes.

26123 (LBL—13500, pp 5.11-5.14) **Effectiveness and implications of technical innovations to reduce water use.** Sathaye, J.A.; Ritschard, R.L.; El-Gassier, M.M.; Rainey, S.C. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The study concentrates on three areas of concern: agriculture, industry, and domestic consumption. For each area, we examine the application of water-saving innovations in a specific geographical region. We examine agricultural water use in the Northern Great Plains Region, industrial use in the Great Lakes Region, and domestic use in the Lower Colorado Region, as well as potential for savings in each area.

26124 (PNL—4709) **Identification and preliminary characterization of global water resource issues which may be affected by CO_2-induced climate change.** Callaway, J.M.; Cohen, M.L.; Currie, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84011127.

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The objectives were to: (1) identify, characterize, and define existing or projected regional and global water resource management issues which may be affected by CO_2-induced climate changes; and (2) develop research priorities for acquiring additional information about the potential effects of a CO_2-induced climate change on the availability and allocation of freshwater supplies. The research was broken into four work elements: (1) identification of water resource management issues on a global and regional basis; (2) identification of a subset of generic CO_2-related water resource management issues believed to have the highest probability of being affected, beneficially or adversely, by a CO_2-induced climate change; (3) selection of specific sites for examining the potential effect of a CO_2-induced climate change on these issues; and (4) conducting detailed case studies at these sites, the results from which will be used to identify future research and data needs in the area of water resources. This report summarizes the research related to the first three work elements. 6 figures, 9 tables.

26125 (PNL-SA—11978) **Ancillary benefits of acid deposition reduction policies.** Moe, R.J.; Currie, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 9p. (CONF-840269—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010697.

From NAPAP Task Group G peer review meeting; Burlington, VT, USA (14 Feb 1984).

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In addition to reducing the damages directly associated with acid deposition, proposed deposition reduction and mitigation policies may also have ancillary physical, biological, and economic effects entirely unrelated to acid deposition. For example, installation of flue gas desulfurization equipment, while reducing levels of acid deposition, may also reduce ambient concentrations of sulfur oxides (SO/sub x/). These concentration reductions may in turn affect human health, visibility, and plant growth. These effects may be of significant value to society and thus should be considered in benefit-cost analyses of the corresponding deposition reduction or mitigation policies. A large number of studies related to the potential ancillary effects of acid deposition policies and the economic values of these effects have been performed. In this research, this literature will be reviewed. The potential ancillary benefits of four acid deposition policy options will be identified and characterized. Estimates of the economic values of these effects will also be identified. These estimates and the literature in general will be evaluated for their usefulness in the 1987 Integrated Assessment. Finally, the theoretical literature on environmental economics and benefit-cost analysis will be reviewed. A rationale for or against inclusion of ancillary benefits in a benefit-cost analysis will be developed. 18 references.

26126 **Department of Energy fiscal year 1984 budget on environment programs. Hearing before the Subcommittee on Natural Resources, Agriculture Research and Environment, U.S. House of Representatives, Ninety-Eighth Congress, first session, 19 Apr 1983.** Washington, DC; Government Printing Office (1984). 72p.

DOE Director Alvin W. Trivelpiece and Deputy Assistant Secretary for Environment, Safety and Health Robert W. Davies testified on why the administration made major budget cuts in nonnuclear health and environment programs when a 50% increase above the current $300 million budget is needed just to maintain the current reduced staff. Research on the health and environment effects and risk analyses associated with energy technologies were either scaled down or eliminated in the 1984 budget. Trivelpiece argued that programs were consolidated to eliminate duplication, and that the $210 million request will be adequate for data compilation and analysis. Davies reviewed DOE health and safety goals for the year, which will focus on personnel at DOE facilities. Both defended the administration's approach to such issues as acid rain, toxic wastes, and cancer research. An appendix with questions and answers for the record follows the testimony.

26127 **Environmental research and development. Hearing before the Subcommittee on Toxic Substances and Environmental Oversight, United States Senate, Ninety-Eight Congress, first session, October 17, 1983.** Washington, DC; Government Printing Office (1984). 277p.

Part 2 of the hearing record covers the testimony of seven government administrators of federal environmental research and development programs. The hearing was held to evaluate these programs in terms of their effect on decision making and the adequacy of current funding levels. The witnesses represented the acid precipitation assessment program, the National Science Foundaton, DOE, the National Oceanic and Atmospheric Administration, US Geological Survey, National Institutes of Environmental Health Sciences, and the Environmental Protection Agency.

2904 Natural Resources

REFER ALSO TO CITATION(S) 25325, 26102, 26123, 26146

26128 (DOE/CE/40596—T1, pp 503-506) **Impact of water conservation programs on American industry.** Zeman, S. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340.

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The following are discussed: realizing savings through water management programs, employee participation and education, and leading the way toward water conservation and management. (MHR)

26129 **(N—8410352) Successes, shortcomings in using production wastes as raw material.** Glushenkova, L. (Joint Publications Research Service, Arlington, VA (USA)). Oct 1983. 6p. NTIS, PC A06.

In USSR rept.: Sci. and Technol., No. 19 (JPRS-84497) p 32-37 (See N84-10348 01-31). Translated from Prom. Belorussii (Minsk), No. 5, 40-43(May 1983).

The economical and rational use of all forms of resources under modern conditions is a task of nationwide significance. Its urgency is caused by factors such as the progressively growing need for raw material, fuel, energy, and supplies, the limited and non-renewable nature of many minerals, and the difficult conditions of mining them and transporting them to where they are needed.

26130 **(TVA/OACD—84/2) Nature and impact of TVA's agricultural resource development program.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). 1984. 30p. NTIS, PC A03/MF A01. Order Number DE84901034.

The TVA agricultural development program, initiated in the 1930s, was an integrated effort of many agencies and institutions working at the grassroots with the people. TVA provides a regional development orientation to augment the educational mission of the universities. It deals with developing and using local resources, relates agriculture to total development, involves incentives to encourage individuals to try new technology, and frequently involves a research component. The cooperative program has provided a way to identify, assess, and solve problems quickly. The thrust has been to evaluate and demonstrate benefits from using new technology under a wide range of farm conditions. This publication identifies program objectives and how program emphasis has changed over the years. It also provides examples of impact on agricultural development during the past 50 years.

26131 **(TVA/PUB—84/25b) Guntersville Reservoir land management plan. Appendix 1. Public involvement.** (Tennessee Valley Authority, Knoxville (USA)). 1981. 372p. NTIS, PC A16/MF A01. Order Number DE84900931.

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As part of a program to manage its 38,000 acres of public land surrounding Guntersville Reservoir in northern Alabama and Tennessee, the Tennessee Valley Authority initiated a series of public meetings, the public concerns expressed would be combined with TVA recommendations to produce land management goals for the next 10 years. This appendix contains draft and final goals, public comments and responses, and mailing lists. (ACR)

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 25298, 25650, 25651, 25874, 25877, 25998, 26126, 26150, 26153, 27096, 27178, 27383, 27625, 27628

26132 **(DOE/MA—0064/2-Vol.3) Congressional budget request, FY 1985. Volume 3. Energy supply research and development.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Feb 1984. 340p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84009778.

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Budget requests for fiscal year 1985 are tabulated for the following research areas: environmental safety and health; liquefied gaseous spill test facilities; biological and environmental research; magnetic fusion; supporting research and technical analysis; and supporting services. A program overview is presented for each area. (DMC)

26133 **(DOE/MA—0064/2-Vol.4) Congressional budget request, FY 1985. Volume 4. General science and reseaurch; uranium enrichment; geothermal resources development fund.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Feb 1984. 12p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84009779.

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Budget requests for fiscal year 1985 are tabulated for the following research areas: general science and research; high energy physics; nuclear physics; general science program direction; and uranium enrichment. Separate overviews for each research area are provided. (DMC)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 25526, 25941, 25998, 26032, 26132, 26133, 27063

26134 **(NUREG/BR—0025-Vol.10-No.2) Information report on state legislation.** Landau, M. (Nuclear Regulatory Commission, Washington, DC (USA). Office of State Programs). 10 Mar 1984. 9p. NTIS, PC A02/MF A01 - GPO*. Order Number DE84900736.

This newsletter lists nuclear-power-related legislation enacted or pending in state legislatures for first quarter of 1984. It also discusses the NRC requesting State health departments to help locate radioactive metal table bases manufactured in a Mexican boundry and distributed in the US. Other NRC activities are briefly mentioned. (GHT)

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 26155, 26241, 26242, 26250

2910 Conservation

REFER ALSO TO CITATION(S) 26113, 26139, 26140, 26141, 26142, 26177, 26180, 26194, 26215, 26218

26135 (LBL—13500, pp 5.27-5.29) **Analysis of appliance efficiency standards.** McMhon, J.E.; Levine, M.D.; Herring, H.J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Synchronous with the improvements to the ORNL/LBL Residential Energy Demand Model, input data were updated to include recent survey data on the following: efficiency of new appliances; current housing construction practice; appliance retirments as a function of age; and saturation of appliances in new houses and in the existing housing stock. In addition, the fuel price projection of the National Energy Policy Plan was utilized. The DOE Engi-

neering Analysis provided estimates of the purchase cost of each appliance as a function of efficiency. A baseline simulation provided estimates of future energy consumption for each of the products. Then, a second simulation was performed using the same input data and model but assuming the efficiencies of regulated products to be at or above the proposed US DOE Consumer Product Efficiency Standards.

26136 (LBL—13500, pp 5.45-5.48) **Energy conservation in Kenya: progress, potentials, problems.** Schipper, L.J.; Hollander, J.M.; Milukas, M.V.; Alcamo, J.; Meyers, S.P.; NOll, S. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The study has four purposes: (1) to characterize the flows of commercial energy in the Kenya economy; (2) to assess progress made to date in energy conservation in Kenya; (3) to determine the potential role for conservation in future Kenyan energy and economic development; and (4) to make recommendations for development of Kenyan conservation policies and international assistance programs. To accomplish these purposes, the study determined Kenyan oil and electricity use by sector and industry, quantified progress in conserving energy already made by individual firms, estimated the future potential for energy conservation in all sectors, and evaluated some of the major barriers to achieving this conservation potential.

26137 **(NP—4901056) End-use research status report. Quarterly report, January 1, 1984-March 31, 1984.** (Public Service Co. of New Mexico, Albuquerque (USA)). 1984. 27p. Public Service Co. of New Mexico, Alvarado Square, Albuquerque, NM 87158.

Solar end use projects financially assisted by Public Service Company of New Mexico are updated for commercial and residential buildings.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 25336, 25787, 26098, 26099, 26100, 26136, 26147

26138 **(DOE/EIA—0420/1) Documentation of the PURHAPS industrial demand model. Volume I. Model description, overview, and assumptions for the Annual Energy Outlook 1983.** Werbos, P.J. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Apr 1984. 72p. NTIS, PC A04/MF A01 - GPO; GPO Dep. Order Number DE84010851.

The use of energy in the agriculture, construction, and mining sectors is detailed. Data for these sectors is sparse, and it forces a conservative (downward biased) approach to forecasting; nevertheless, explicit analysis of these sectors avoids the greater bias which would occur, for example, if one projected a drop in tractor fuel or drill rig fuel based on fuel switching or conservation in manufacturing. These and other changes in the PURchased Heat and Power System (PURHAPS) are explained as well as the overall logic of PURHAPS and demand elasticities, access and use methodology, the model data bases, and the programs used to construct the data bases. In Appendix A, statistics are provided for model documentation.

26139 (LBL—13500, pp 5.32-5.34) **Analysis of energy conservation measures in residential buildings.** Ingersoll, J.G.; Huang, J.; Mass, J.J.; Levine, M.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The energy analysis of single-family residential buildings was completed during the year. Prototype designs were produced for one-story, two-story, multi-level, and townhouse, and these designs were analyzed for 48 cities. Foundation types were modeled for basement, slab on grade, and crawl space. Depending on the degree of usage, foundation types were analyzed for that city. The information on usage of foundation types, as well as all other building characteristics used in the design of the four prototype buildings, was obtained from relevant 1979 reports of the National Association of Homebuilders Research Corporation. For each prototype with a specific foundation type, between 15 and 20 different levels of envelop thermal integrity were analyzed in every city.

26140 (LBL—13500, pp 5.35-5.38) **Assessment of energy conservation rating systems.** Cleary, P.G.; Ingersoll, J.G.; Mass, J.J.; Levine, M.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Computer-based calculations were used to construct a score card for energy-use estimation that is both accurate and simple and has wide-scale applicability. The processing method is a development of the effective degree-day emthod.

26141 (LBL—13500, pp 5.41-5.45) **Analysis of energy conservation measures in commercial buildings.** Turiel, I.; Boschen, D.A.; Levine, M.D.; Smith, J.R.; Zentner, M. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

An energy and life-cycle cost analysis was made of a six-story, 100,000-square-foot office building. The building energy analysis computer program, DOE-2.1, was used to obtain annual energy consumption by end use. Annual energy used for the base-case building and for several energy-conserving designs, plus initial added cost of the energy-conserving measures, served as input to a life-cycle cost model (LCCM). The LCCM is used to assess the economic costs and benefits, with reference to a base-case building, to the commercial building owner who constructs a new building of varying initial owner who constructs a new building of varying initial cost and energy efficiency. The conservation measures evaluated include: building orientation, added insulation, single and double glazing with varying solar transmission, use of daylighting, and use of night setback thermostats.

26142 (LBL—13500, pp 5.49-5.52) **Indicators of residential energy use and conservation.** Schipper, L.J.; Meyers, S.P.; Ketoff, A.N. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Residential energy consumption is a function of the structure and intensity of energy use. Structural factors both define tasks for which energy is used and shape the way in which it is used. Energy intensities tell us how much energy is used for a given task and are in part determined by the structural factors existing in a particular place. Energy per dwelling, energy per ton of industrial output, and energy per passenger mile are ll intensities. Both structure and intensity are affected by economic factors, especially household incomes and energy prices. To assess changes in energy use patterns, energy intensities and structural factors were used to form energy indicators. An example is the indicator Head/dw/DD, the average energy used for space heating per dwelling per degree-day. Comparing the intensity heat/dw between years within a country of among countries ignores the effect of climate. By dividing this intensity by an average number of degree-days, an approximate measure of the need for heating, adjusted for climate variation is found.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 25318, 25941, 25998, 26126, 26127, 26134, 26266

26143 **(NP—4770233) France - energy situation 1982.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1983. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84770233.

The energy situation of France is reviewed on the basis of some relevant data. Its energy policy is commented on, and developments in electric power generation are described as well as the trends observed for the various energy sources. Figures are given on external trade.

26144 (NP—4770234) Bolivia - energy situation 1981/82. (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Sep 1983. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770234.

The energy situation of Bolivia is reviewed on the basis of some relevant data. Its energy policy is commented on, and developments in electric power generation are described as well as the trends observed for the various energy sources. Figures are given on external trade.

26145 (NP—4770237) Finland - energy situation 1982. (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Oct 1983. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84770237.

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The energy situation of Finland is reviewed on the basis of some relevant data. Its energy policy is commented on, and developments in electric power generation are described as well as the trends observed for the various energy sources. Figures are given on external trade and the balance of payment.

26146 Energy and water development appropriations for 1985. Hearings before a subcommittee of the Committee on Appropriations, House of Representives, Ninety-Eighth Congress, second session. Washington, DC; Government Printing Office (1984). 1925p.

Part 4 of the hearing record covers DOE budget justifications for atomic energy defense activities; energy supply, research, and development; the Nuclear Waste Fund; general science and research; uranium enrichment; the Geothermal Resources Development Fund; power marketing and departmental administrations; and the Federal Energy Regulatory Commission. Highlights from the budget note that it continues support for a mix of energy technologies and a commitment to energy security. The budget incorporates and reflects savings initiatives that will save an estimated $143.5 million over the 1984-85 period.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 25246, 25289, 25290, 25296, 25296, 25298, 25298, 25313, 25314, 25315, 25316, 25317, 25318, 25319, 25320, 25320, 25321, 25321, 25322, 25322, 25336, 26094, 26101, 26102, 26103, 26104, 26105, 26106, 26118

26147 (DOE/EIA—0035(84/01)) Monthly energy review, January 1984. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Apr 1984. 115p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84010884.

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This document presents current data on production, consumption, stocks, imports, exports and prices of the principal energy commodities in the US. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. Data are tabulated under the general headings: energy consumption; petroleum; natural gas; oil and gas resource development, coal; electric utilities; nuclear; price; and international.

26148 (DOE/EIA—0130(84/02)) Natural gas monthly. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Feb 1984. 115p. NTIS, PC A06/MF A01; - GPO; GPO Dep. Order Number DE84010427.

Dry gas production during February 1984 was estimated at 1,459 billion cubic feet (Bcf), 9.6% above February 1983 dry gas production on a daily average basis. Consumption of natural gas during February 1984 was an estimated 1,754 Bcf. The daily average of 60.5 Bcf was 2.6% above that of February 1983. Compared to the previous January, residential consumption was up 13.3%, commercial consumption was up 18.2%, industrial consumption was up 9.3%, and electric utility consumption was up 3.4%. The volume of working gas in underground storage reservoirs at the end of February 1984 was 20.3% below a year ago. Net withdrawals from underground storage were 236 Bcf. The average wellhead price of natural gas in December 1983 was $2.58 per thousand cubic feet (Mcf). In December 1982, the average was $2.62 per Mcf. In February 1984, the average residential price of natural gas was $5.99 per Mcf. The comparable price in February 1983 was $5.85 per Mcf. The average wellhead (first sale) price for natural gas purchases projected for March 1984 by selected interstate pipeline companies was $2.76 per Mcf. In March 1983 the average price was $2.81 per Mcf. The average price projected for Old Gas (NGPA Sections 104, 105, and 106) in March 1984 was $1.33 per Mcf; for New Gas (NGPA Sections 102, 103, 108, and 109), $3.59 per Mcf; and for High Cost Gas (NGPA Section 107), $5.25 per Mcf. In March 1983 the prices projected for Old Gas, New Gas, and High Cost Gas averaged $1.43, $3.37, and $6.75 per Mcf, respectively.

26149 (DOE/EIA—0391(84)) Model documentation: short-term integrated forecasting system demand model, 1984. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1984. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011315.

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The Short-Term Integrated Forecasting System (STIFS) Demand Model consists of a set of energy demand and price models that are used to forecast monthly demand and prices of various energy products six quarters in the future. The STIFS demand model is based on monthly data (unless otherwise noted), but the forecast is published on a quarterly basis. All of the forecasts are presented at the national level, and no regional detail is available. The model discussed in this report is the February 1984 version of the STIFS demand model. The relationships described by this model include: the specification of retail energy prices as a function of input prices (for example, the world oil price where appropriate), seasonal factors, and other significant variables; and the specification of energy demand by product as a function of price, a measure of economic activity, and other appropriate variables. Commodities covered are: gasoline, distillate, fuel oils, residual fuel oils, power generation, coal and other petroleum products. 27 references, 3 figures, 45 tables.

26150 (DOE/ET/60004—T4) Analytical framework for assessing federal R and D strategies on liquid and gaseous fuels. Nesbitt, D.M.; Marshalla, R.A. (Decision Focus, Inc., Los Altos, CA (USA)). Sep 1980. Contract AC05-79ET60004. 309p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84011238.

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This volume describes the structure of the framework developed to analyze federal R and D alternatives for liquid and gaseous fuels. Some of the work presented here has been identified as important in previous studies for DOE Fossil Energy, and some has been identified as important during this specific project. In a sense, the purpose of this volume is to discuss and relate a broad range of issues important to federal liquid and gaseous fuel R and D decisions. Because the range of issues dealt with here is so broad, it is impossible to integrate them all simultaneously into any given analysis. However, by presenting them carefully on a consistent basis, we hope that future cost-benefit analyses will be able to consider more of them than is now possible. Discussion is presented under the headings: network representation of the US economy; cost-benefit analysis of government decisions; a model of the firm and its implications for supply curves, and public sector perspective of R and D. 37 figures.

26151 (DOE/FE/30081—T1) Arctic offshore oil and gas technology. Sackinger, W.M. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Nov 1982. Contract FG01-81FE30081. 232p. NTIS MF A01; 2; GPO Dep. Order Number DE84008916.

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This technical background briefing report is intended to assist in planning engineering research oriented toward Arctic offshore oil and gas recovery. The current five-year leasing schedule for the ice-prone waters of the Arctic offshore has been illustrated in Figure E-1. In Figure E-2 and Table I, the estimated reserves for

these areas are given, based on National Petroleum Council estimates (December 1981). In view of the world petroleum situation since 1973, the probability of successful exploration and production from some areas of the Arctic offshore, at some time in the foreseeable future, is very high. The flow chart in Figure E-3 relates the special Arctic factors, such as ice and permafrost, to the normal petroleum production sequence. Other current technological frontiers are identified in the final section of this report. All of the subjects mentioned there should be advanced, to extract Arctic offshore oil and gas in an optimized and economic manner. Fortunately, the required technology is within reach. With the coordinated efforts of industry and government, and the allocation of sufficient resources in a timely manner, all of these technical advances can be accomplished in the decade ahead. 231 references, 134 figures, 1 table.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 26103, 26104, 26105, 26106, 26266

2960 Electric Power

REFER ALSO TO CITATION(S) 25650, 25651, 26250, 27095

26152 **(DOE/EIA—0226(84/01)) Electric power monthly, January 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1984. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008556.

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The Electric Power Monthly (EPM) includes comprehensive information about the electric utility industry in the United States. Current data, aggregated in the previous formats of these publications, are available. The summarized data contained in this report are presented for the use of a wide audience including Congress, Federal and State agencies, the electric utility industry, and the general public. The data presented in this report were collected and published by the Energy Information Administration (EIA), US Department of Energy, to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974.

26153 **(DOE/MA—0064/2-Vol.5) Department of Energy FY 1985 Congressional budget request. Power marketing administrations and Departmental administration. Volume 5.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Feb 1984. 312p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84009782.

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Budget requests for fiscal year 1985 are presented for the Alaska Power Administration, the Southeastern Power Administration, the Southwestern Power Administration and the Western Area Power Administration. Separate program the overviews are included for each power marketing administration. (DMC)

26154 **(DOE/RG/06566—T1) State of New Mexico Attorney General's Office, Consumer and Economic Crimes Division energy unit. Period of the Grant, October 1977-September 1980.** Biderman, P. (New Mexico State Government, Santa Fe (USA)). 1 Jul 1981. Contract FG01-78RG06566. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008891.

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This report outlines the last three years of effort and achievement by New Mexico's Office of Consumer Services, which has been funded during that period largely by Department of Energy funds. As the following narratives reveal, the focus of our Office's efforts, the resources we have brought to bear, and the successes that have resulted, have contributed to major changes in our State's regulation of investor-owned electric utilities. The investment of several hundreds of thousands of dollars in the establishment of our Office has not only saved ratepayers many millions of dollars in unneeded utility rates, but have also promoted policies consistent with conservation, load management, fair distribution of costs, and more intensive regulatory scrutiny. We believe that the public interest of New Mexico has benefited immensely from our federal grant funds during this transitional period, and that future utility regulatory efforts are likely to prove much less costly because of the groundwork that has been laid these past few years.

26155 **(DOE/RG/10511—T1) Oklahoma Corporation Commission PURPA program. Final progress report, October 1, 1980-September 30, 1982.** (Oklahoma Corp. Commission, Oklahoma City (USA)). 22 Mar 1983. Contract FC01-80RG10511. 325p. NTIS, PC A14; 3; GPO Dep. Order Number DE84007325.

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Following an overview section, Section II describes the concerns of potential cogenerators and small power producers in Oklahoma about tariffs, interconnection arrangements and other aspects of their generation activities. Section III gives equal time to the utilities' concerns. In Section IV are highlights of the avoided cost estimation methodology developed during the project. This methodology was then applied to Oklahoma Gas and Electric Company (OG and E) as described in Section V. The next step was to use the avoided costs developed for OG and E as the basis for sample rates. These are described in Section VI. An analysis of alternative tariff forms and contract terms is described in Section VII. Section VIII summarizes cogeneration and small power production developments in other states. Finally, Section IX offers some general recommendations to the Commission in their future diliberations on this important subject.

26156 **(EPRI-EA—3387) Load management strategy testing model case study. Final report.** Barrager, S.M.; Buckley, O.E.; Clark, C.E. Jr.; Fancher, R.B.; Shealy, M.; Stengel, D.N. (Decision Focus, Inc., Los Altos, CA (USA)). Feb 1984. 132p. EPRI, Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report describes a case study of load management strategies for Public Service of Oklahoma by Decision Focus Incorporated using the EPRI Load Management Strategy Testing Model (LMSTM). The primary purpose of the study was to test and demonstrate LMSTM using actual utility data. The study analyzed four load management strategies: (1) a conservation strategy with a residential insulation program, (2) a direct load control strategy with air conditioner cycling and demand subscription, (3) a time-of-day strategy with time-of-use meters on most customers, and (4) a hybrid strategy combining elements of the first three strategies. A strategy with no load management was included for comparison. The report presents model results indicating the impacts of the strategies on customer loads, generation dispatch, financing, and rates. The strategies are evaluated and ranked based on the LMSTM evaluation submodel. The results are preliminary and do not represent an exhaustive analysis of load management for Public Service of Oklahoma. The LMSTM was successful in performing cost-benefit analyses on a wide range of load management options.

26157 **(LALP—84-1) Electric utility reports, winter 1983.** Ford, A.; Sutherland, R. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011265.

This bibliography lists reports and publications on electric utility issues written at the Los Alamos National Laboratory from 1976 through 1983. The theme of these publications is economic analysis, and most of the work was completed by the Economics Group. However, some related contributions from the Statistics Group and Energy Technologies Group are included. Papers and reports involving simulation modeling of the regulatory and financial issues at individual electric utilities are listed. Papers and reports explaining the structure and applications of the Los Alamos Coal and Electric Utility Modeling System, which has been used to analyze industry issues at the regional and national levels as well as environmental constraints to electricity generation are included. A listing of our econometric studies of the demand for electricity and of the reliability of nuclear power as well as economic studies of small versus large power plants are presented.

26158 (SSM—8308) Operation of the large interconnected power system by decision and control in emergencies. Final report. Zaborszky, J.; Huang, G. (Washington Univ., St. Louis, MO (USA). Dept. of Systems Science and Mathematics). Sep 1983. Contract AC01-79ET29367. 219p. NTIS, PC A10; 3; GPO Dep. Order Number DE84010859.

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Techniques for the computer aided operation and control of the large interconnected power system in its Normal, Alert, Emergency and Restoration conditions were in the process of development at Washington University under consecutive sponsorship by NSF-RANN, ERDA and DOE for the last 15 years. At this point at least a broad based consistent foundation for the computer aided operation and control of the large power system is accomplished. Since this body of results is now scattered in some 45 separate publications it seems timely to discuss the overall accomplishments in a summary fashion as is done here. These results differ from the state of art of the control centers on the power system in being more consistent and much more complete (e.g. computer aided emergency control or restoration as defined here are not state of art) more up to date in parts (e.g. automatic generation control has 1950's servomechanism implementation in the state of art) and most of all by being a mathematically and computationally sound large system approach taylored to the operating needs and basic structure of the system itself, not to the imposition of existing solution or computation techniques.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 25289, 25290, 25315, 26090, 26100, 26147, 26148

26159 (DOE/EIA—0384(83)) Annual energy review, 1983. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 20 Apr 1984. 253p. NTIS, PC A12/MF A01; 1 - GPO; GPO Dep. Order Number DE84010482.

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Major energy developments during 1983 are discussed for production; consumption; exploration and development; crude oil production; petroleum imports, refining, stocks, and consumption; natural gas; coal; electric power; prices; global aspects of production, prices, and stocks. Electric power, nuclear power, geothermal and solar energy are also addressed. In addition to a glossary, units of measure, conversion factors, price deflators and energy equivalents are presented.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 25619, 25629, 25665, 26101, 26102

26160 (ANL/CNSV-TM—127, pp 65-67) **Role of NWEA.** Keenan, D. (National Wood Energy Association, Mt. Pleasant, MI). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The National Wood Energy Association was established to: encourage through the use of responsible forest, agricultural and land management practices, public and private participation in the development of wood as a renewable energy source compatible with other wood uses; unite in this cooperative effort small and large firms, public and private organizations, and individuals involved with, interested in and dedicated to the improvement and productivity of our nation's wood resource; focus consumer and legislative attention on this nation's greatest untapped renewable industrial energy resource and underscore its contribution towards economic strength and energy independence on national and local levels.

26161 (ANL/CNSV-TM—127, pp 69-76) **Future biomass energy industry.** Levine, L.S. (JAYCOR, Alexandria, VA). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

In this brief paper, comments are made on the nature of the biomass energy industry today and some predictions as to what it will look like in the future. No reasonably cautious person who has been associated with energy development over the past five to ten years would undertake any such predictions of the future. Therefore, the focus of this paper is on what are, to my mind, the unique characteristics of biomass energy which have shaped the industry as it exists today and are likely to shape its future evolution. Also discussed are those R & D developments which will broaden the range of possibilities for a future biomass energy industry. From these two bases, the reader can draw his own conclusions about the most likely shape of the industry three or five, or perhaps even twenty years from now.

26162 (ANL/CNSV-TM—127, pp 77-79) **Mechanisms for introducing innovations in biomass technologies.** Brown, H.L. (Brown Venture Management Co., Richardson, TX). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

This paper briefly examines the generic process that the author has observed to be successful for entrepreneurs who turn ideas into enterprises, and traces the path of a biomass technology idea to the point of a commitment of start-up venture capital. The basic outline the author suggests includes: (1) Raise seed money for completion of lab work and the feasibility study (tentative commitment). (2) Engage a major engineering lab to conduct the study and work under your direction. (3) Take in a partner to develop the initial market for the technology in the pulp mills. (4) Raise venture capital from major chemical firms that wish to market the products worldwide. (5) Build a modular prototype plant to demonstrate the integrated concepts, and to transport to a foreign source of biomass. This country would agree to license the technology and install the first full-scale plant if tests are successful. (6) Once proven in the target market, bring the technology back to the US in the proper form and in the right time frame to be most profitable. (7) Take in a major forest resource owner as partner to exploit the technology in competition with US producers of chemicals. In essence, this would build an Eastman or Celanese from the ground up.

26163 (DOE/CE/15095—10) Homemade electricity: an introduction to small-scale wind, hydro, and photovoltaic systems. Smith, D. (National Center for Appropriate Technology, Butte, MT (USA)). Mar 1984. Contract AC01-82CE15095. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007530.

Homemade Electricity leads prospective power producers through a series of questions that will help them decide if generating their own electricity is right for them. Each technology - wind, micro-hydro, and photovoltaics - is also introduced, describing preliminary considerations and emphasizing the lessons learned through the in-the-field testing of the grants projects. Finally, additional sources of information are included to help novice electricity producers answer questions that will arise, and a glossary to explain some of the terms associated with the three technology areas.

26164 (DOE/CH/10122—20) Project status report on field research tasks and technical services, June 1, 1983-September 30, 1983. (ESG, Inc., Atlanta, GA (USA)). Oct 1983. Contract AC02-82CH10122. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009899.

This status report covers progress during the period June 1, 1983 through September 30, 1983. The work is divided into two areas as follows: (1) Field Measurement, Analyses, and Reporting Related to Building Energy Systems and Biomass Projects. The key effort is on the Class B performance monitoring program, including a limited amount of special data evaluation and analysis. Other work relates to design tools, passive selection criteria, hot water performance documentation, and other renewable systems. (2) Technical Services in Support of Appropriate Technology Program. A total of 84 project files have been reviewed and summarized, telephone contacts and selected site visits are being made on a small number of active projects, and technical information dis-

semination tasks are underway. A summary paper on project activities was prepared, approved, and finalized for publication.

26165 (LBL—13500, pp 2.15-2.16) **Appropriate energy technology.** Lucarelli, F.B.; Kessel, J.D.; Clark, H.R.; Kay, J.M.; Linse, J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

26166 **(P—103-83-001) California's solar, wind, and conservation tax credits.** Modisette, D.L. (ed.). (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Dec 1983. 177p. CEC, 1516 9th Street, Sacramento, CA 95814.

In 1976, the State of California established a program of tax incentives to encourage installation of solar energy systems. Since that time the Legislature has continued to refine these incentives: ensuring an efficient and complementary tie-in to similar federal incentives; reducing or eliminating credits for technologies which no longer benefit from them; expanding elibibility for other technologies; and extending the time period during which these incentives are offered. In 1981 a similar tax incentive program was established for energy conservation measures. Both tax credit programs have proven to be very popular, since approximately 780,000 taxpayers had filed claims through 1982. In 1983, California's tight fiscal situation sparked a debate on the continuation of these credits. The California Energy Commission evaluated several of the major impacts of both credits, including: state treasury impacts; energy savings; environmental benefits; cost-effectiveness; and growth of solar and wind companies. Although this report is not a complete evaluation of these credits, it does contain innovative analyses which have advanced California's ability to assess these and similar programs. The Commission's Tax Credit Committee emphasizes the need for additional analysis if the reader is seeking a thorough evaluation of California's energy tax credits.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

26167 (ANL—83-55, pp 78-84) **Magnetohydrodynamic heat and seed recovery technology.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The Chemical Technology Division has become the lead ANL division in a multidivisional effort (designated the MHD Heat and Seed Recovery Technology Project) that is directed toward developing the technology required for the design of the components for the MHD bottoming cycle. This work is being done in cooperation with other DOE contractors, including Babcock & Wilcox, University of Tennessee Space Institute, and Mississippi State University. Much of the CMT work for the design and operation of MHD steam plant components involves experiments that are performed at a combustion test facility, the Fossil Energy Users Laboratory (FEUL). Experiments that have been conducted to date are related to (1) the control of NO/sub x/, SO/sub x/, and particle emissions, (2) fouling of convective steam heaters, and (3) the design of radiant boilers. The program is described.

26168 **(DOE/ET/10815—89) Quarterly technical progress report, October-December 1982 on Energy Conversion Research and Development Programs.** (Tennessee Univ., Tullahoma (USA). Space Inst.). Oct 1983. Contract AC02-79ET10815. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84005855.

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In this quarterly technical progress report, UTSI reports on the continued design work for the low mass flow train superheater. The detailed design of this component continued and the overall arrangement drawing for the superheater and air heater was finalized. The air heater procurement reached the point of contract award, but the actual purchase order award was held up pending receipt of additional funding from the Department of Energy. Testing activity reported includes two additional tests in the LMF1C series, which concludes this test series. Test data are presented, along with preliminary analyses for the combustor, nozzle, diagnostic channel, diffuser, radiant furnace/secondary combustor and Materials Test Module. In addition to the nitrogen oxide test measurements, corrosion and erosion rates for the boiler tube specimens and the materials test module are reported.

26169 **Ceramic to metal attachment system.** Marchant, D.D. (to Dept. of Energy). US Patent Application 6-503,128. 10 Jun 1983. 8p. Contract AC06-76RL01830.

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A composition and method are described for attaching a ceramic electrode to a metal conductor. A layer of randomly interlocked metal fibers saturated with polyimide resin is sandwiched between the ceramic electrode and the metal conductor. The polyimide resin is then polymerized providing bonding.

3004 Thermionic Converters

26170 **(FEI—1266) Thermoemission power. Pt. 2.** Kuznetsov, V.A.; Shcherbinin, P.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1982. 41p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701411.

The status and prospects of using thermoemission coverters (TEC) in space and on Earth are reviewed. The results of testing the first in the world Topaz thermoemission nuclear reactor-converter are considered. The possibilities of TEC applications as a low-temperature part of a thermonuclear reactor or for conversion of laser radiation into electric power are discussed. The Topaz reactor represents heterogeneous nuclear reactor with in pile TEC. TEC emitter is made of the VM-1 molybdenum alloy and its collector is made of the VN-2 niobium alloy. The reactor has operated in the process of tests during several thousands of hours at power of 5-7 kW. The conclusion is made that practically achieved parameters of TEC give an opportunity to design on their basis independent power supplies for space vehicles and distant areas. TEC application provides conditions for considerable increase in the efficiency of usual, nuclear and radioisotope power.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 25191, 26545

26171 (ANL—83-55, pp 56-62) **Advanced fuel cell development.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The fuel cell is one of the most promising technologies being developed by DOE to reduce the nation's reliance on petroleum fuels for electrical generation. Within the DOE fuel cell development program, CMT provides technical support to DOE for contractor efforts on advanced fuel cell development, undertakes supporting research and development for the molten carbonate fuel cell (MCFC) program, and is developing advanced design concepts for the solid oxide fuel cell (SOFC). The R and D is focused on critical problem areas for fuel cells, with special emphasis on developing alternative concepts and obtaining fundamental understanding of fuel cell behavior. R and D activities are discussed.

26172 **(N—8411581) Develop and test fuel cell powered on-site integrated total energy system.** (Englehard Industries, Edison, NJ (USA)). Sep 1983. 23p. (NASA-CR—168159; DOE/NASA—0241-7). NTIS, PC A02/MF A01.

Test results are given for a 5 kW stack and initial results for an integrated, grid connected system operating from methanol fuel. Site selection criteria are presented for future demonstration of a 50 or 100 kW OS/IES. Preliminary results are also given with approximate internal rates of return to the building owner. Progress in development and construction of a 50 kW modular methanol/steam reformer is reported.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 25603, 26109, 26110, 26111, 26112

3201 Buildings

REFER ALSO TO CITATION(S) 26164, 26227, 26649, 26901, 26902, 26932, 26958, 26959, 27011, 27012, 27013, 27014, 27015, 27016, 27017, 27018, 27019, 27020, 27021, 27022, 27109, 27186

26173 **(BMFT-FB-T—83-243) Rating of thermostatic radiator valves - criteria and testing methods.** Ast, H.; Striebel, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 285p. (In German). NTIS (US Sales Only), PC A13 MF/A01. Order Number DE84750923.

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The object of this project is to determine criteria to use for the rating and comparison of the various thermostatic control valves offered on todays market. The inherent properties of these valves form one group of criteria. These properties are primarily determined by the quality of construction of the valves. Testing methods will be developed and testing equipment will be built in order to establish the quality level. The response of the control mechanism is also influenced by external factors such as the properties of the piping system, the radiator and the room. The influence of these system components on the controller will be examined and displayed using simple graphical methods. General values of energy savings cannot be given, but it is possible to estimate the savings for assumed boundary conditions. The effects of various combinations of valve properties and external influences will be investigated in a test cell under real operating conditions. The degree of external heat utilization is a dimension for the quality of the obtained control valve. The results obtained in experiments and from calculations determine the quality of the thermostatic control units and their operating ranges. High quality construction alone does not insure the production of thigh quality control systems. Careful planning and layout of the system itself are necessary in order to determine the operating ranges precisely so that the optimal control valves can be selected.

26174 **(BMFT-FB-T—83-250) Wear and service life as limitation on the use of small diesel engines for driving heat pumps.** Rietschel, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 133p. (In German). NTIS (US Sales Only), PC A07 MF/A01. Order Number DE84750925.

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A heat pump compressor driven by an internal combustion engine, with recovery of waste heat from the engine, promises the most favourable utilisation of primary energy for all domestic heating systems. For the low-power range - one- to two-family homes - Diesel-driven heat pump units have hitherto not been available from series production. Hence, an appropriate small Diesel engine has been selected, with servicing interval and service life comparable to those for conventional heating plants as the criteria. Under conditions encountered in practice, an suitable engine has been operated under fully automatic control. At intervals of 200 to 600 h of operation, it was disassembled, and the wear was investigated as a function of various operating parameters, such as load, rotational speed, cyclic frequency and cooling water. Except for the piston-and-cylinder system, the engine exhibited after 6760 h of operation a degree of wear which suggests a service life of 15- to 20000 h. If the main moving parts - piston, piston ring and cylinder - are changed after about 7500 h or 5 years of operation, the Diesel engine could attain the lower limit of the projected service life. The variation of the operating parameters resulted in only a slight effect on the wear behaviour of the Diesel engine; in particular, even a large number of hot starts exerts only a very slight unfavourable influence on the wear behaviour. Yearly servicing intervals are possible with the use of hydrotappets and an auxiliary storage vessel for motor oil. The analysis was performed on the basis of hydrodynamic lubrication theory for the load-bearing capability of the lubricant film between piston and cylinder.

26175 **(BMFT-FB-T—83-259) Rational use of energy in the district heating service area of the Stadtwerke Wolfsburg AG.** Berg, L.; Dittert, B.; Panzhauser, E.; Fantl, K.; Ertl, H.; Gockell, B.; Huegin, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 310p. (In German). NTIS (US Sales Only), PC A14 MF/A01. Order Number DE84750927.

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Within this research project, the possibilities of saving energy by structural and control measures have been evaluated for existing multi-family houses. Structural characteristics have been checked using infrared thermography and measuring the air-tightness of window joints in order to guarantee an exact calculation of heat demand and energy consumption. Calculated energy consumption values have been compared with effective values. Structural and control measures for the purpose of energy conservation been developed, calculated, and carried out. The total energy saving potential has been evaluated and compared with expected cost.

26176 **(BMFT-FB-T—83-260) Testing and comparison of different ventilation systems in the 'Solarhaus Freiburg'.** Altenhof, K.; Botzenhardt, K.; Holz, D.; Meier, B.; Tesche, B.; Voss, K.F.; Werner, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 263p. (In German). NTIS (US Sales Only), PC A12 MF/A01. Order Number DE84750933.

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Two different mechanical ventilation systems for an apartment house have been compared. The aim of the research was to find the most economical system considering the needs of the occupants. An extensive data acquisition system allowed to draw up detailed heating energy balances of two heating periods. The acceptance of the ventilation systems has been studied by a psychologist. The supply and exhaust ventilation system under consideration proved to be less economical than the exhaust ventilation system. None of the ventilation systems led to a noticeable lower window opening rate as compared with the other. Both systems were afflicted with a lot of problems and do not represent an adequate solution to energy saving by controlled ventilation.

26177 **(BMFT-FB-T—83-269) Application of the knowledge derived from the KREV on actual building project. KREV-A.** Grossheim, E.O.; Haendly, D.; Kuempel, P.; Reinmuth, F.; Rouvel, L.; Soethout, F.; Strassberger, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 390p. (In German). NTIS (US Sales Only), PC A17 MF/A01. Order Number DE84750918.

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A study already established for the BMFT in 1976 (03E-5126) with the title KREV (Concept for an efficient and economic use and supply of energy demonstrated by the example of the new buildings of the Federal Diet and Federal Council) supplied a variety of new data-substantiated knowledge of the close connection between the building design and technical equiment of the building, the maximum possible luxury and consumption of energy in major buildings. Among the results of special significance derived from the KREV study is the finding that the builder, architect and engineer must cooperate in the earliest stages of the project preparation and planning, in order to be able to efficiently use all possibilities of energy saving. In the follow-up study (KREV-A) the application of knowledge derived from KREV was examined in four real construction projects. Here: Stiftung Liebenau, planned construction and reconstruction project.

26178 **(BMFT-FB-T—83-270) Application of the knowledge derived from the KREV on actual building project. KREV-A.** Brauchle, B.; Haendly, D.; Kuempel, P.; Rouvel, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 93p. (In German). NTIS (US Sales Only), PC A05 MF/A01. Order Number DE84750919.

See also BMFT-FB-T--83-269; 83-271; 83-272. With 4 tabs., 9 figs.

A study already established for the BMFT in 1976 (03E-5126) with the title KREV (Concept for an efficient and economic

use and supply of energy demosntrated by the example of the new buildings of the Federal Diet and Federal Council) supplied a variety of new data-substantiated knowledge of the close connection between the building design and technical equipment of the building, the maximum possible luxury and consumption of energy in major buildings. Among the results of special significance derived from the KREV study is the finding that the builder, architect and engineer must cooperate in the earliest stages of the project preparation and planning, in order to be able to efficiently use all possibilities of energy saving. In the follow-up study (KREV-A) the application of knowledge derived from KREV was examined in four real construction projects.

26179 **(BMFT-FB-T—83-271) Application of the knowledge derived from the KREV on actual building project. KREV-A.** Haendly, D.; Hampe, K.H.; Philipps, M.; Rouvel, L.; Strassberger, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 254p. (In German). NTIS (US Sales Only), PC A12 MF/A01. Order Number DE84750920.

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A study already established for the BMFT in 1976 (03E-5126) with the title KREV (Concept for an efficient and economic use and supply of energy demosntrated by the example of the new buildings of the Federal Diet and Federal Council) supplied a variety of new data-substantiated knowledge of the close connection between the building design and technical equipment of the building, the maximum possible luxury and technical equipment of the building, the maximum possible luxury and consumption of energy in major buildings. Among the results of special significance derived from the KREV study is the finding that builder, architect and engineer must cooperate in the earliest stages of the project preparation and planning, in order to be able to efficiently use all possibilities of energy saving. In the follow-up study (KREV-A) the application of knowledge derived from KREV was examined in four real construction projects. Here: Student Society Oldenburg - planned construction project.

26180 **(BMFT-FB-T—83-272) Application of the knowledge derived from the KREV on actual building project. KREV-A.** Binder, K.; Philipps, M.; Stenns, H.; Reinmuth, F.; Rouvel, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 250p. (In German). NTIS (US Sales Only), PC A11 MF/A01. Order Number DE84750917.

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A study already established for the BMFT in 1976 (03E-5126) with the title KREV (Concept for an efficient and economic use and supply of energy demonstrated) by the example of the new buildings of the Federal Diet and Federal Council supplied a variety of new data-substantiated knowledge of the close connection between the building design and technical equipment of the building, the maximum possible luxury and consumption of energy in major buildings. Among the results of special significance derived from the KREV study is the finding that the builder, architect and engineer must cooperate in the earliest stages of the project preparation and planning in order to be able to efficiently use all possibilities of energy saving. In the follow-up study (KREV-A) the application of knowledge derived from KREV was examined in four real construction projects. Here: Gustav-Heinemann-Haus, Bonn-Tannenbusch - complex of buildings in operation.

26181 (CONF-811048—Summs., pp 7p, Paper 6) **Inexpensive perfluorocarbon tracer technique for wide-scale infiltration measurements in homes.** Dietz, R.N.; Cote, E.A.; Senum, G.I.; Wieser, R.F. (Brookhaven National Lab., Upton, NY). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The perfluorocarbon tracer technique is a precise and reliable methodology for the determination of infiltration rates in homes. The present PFT source has an adequate emission rate and lifetime, but its rate is both time and temperature dependent. A capillary diffusion source with a temperature compensated annular capillary is being investigated for removing both those dependencies. Tests have demonstrated the reliability of both BATS and CATS as PFT samplers. Essentially no further development of the sampling approach is needed. The minature size of both the present PFT source, the proposed diffusion source, and the capillary sampler will allow wide scale implementation of the use of this inflitration measurement approach. (DT)

26182 (CONF-811048—Summs., pp 4p, Paper 55) **Air leakage in some homes retrofitted to save energy.** Dutt, G.S.; Persily, A.K.; Linteris, G.T.; Lavine, M.L.; Goldberg, M.L.; Harrje, D.T.; Socolow, R.H. (Princeton Univ., NJ). 1981. NTIS, PC A13/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Windows and doors represent only a small part of the air leakage in most houses. Many of the major but easily correctable air leakage sites are more obscure. Their detection is greatly facilitated if the house is slightly pressurized or depressurized so that the air leaks are exaggerated and flowing in the same direction. Princeton University's Center for Energy and Environmental Studies has developed an instrumented pressurization/depressurization device known as the Blower Door which is mounted in an exterior doorway. The instruments enable the air leakage rate through the house's cracks to be measured at various pressure differences. Measurements taken before and after air tightness retrofits permit an evaluatioh of their effectiveness. (DT)

26183 (CONF-811048—Summs., pp 5p, Paper 57) **Changes in indoor climate after tightening of apartments.** Korsgaard, J. (Univ. of Aarhus, Denmark). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Energy saving measures consisting in replacing leaky single-glass windows with tight double-glass windows will reduce the heat consumption by 14%. Furthermore, the present results show that the sealing of apartments improves the indoor climate in several respects. The frequency of complaints of draught is considerably reduced in sealed apartments compared with unsealed. The families have invested part of the saved energy in greater indoor thermal comfort as the indoor temperature in winter was 1 to 2°C higher in sealed apartments. (DT)

26184 (CONF-811048—Summs., pp 4p, Paper 58) **Analysis of energy-efficient strategies for increasing ventilation rates in residences.** Lord, D. (National Research Council, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

There are cost-effective ways to minimize indoor air pollution, including proper ventilation and the use of ventilating equipment and air cleaning devices. Recent evaluations of air pollution control systems suggest that some of these control strategies may result in increased acceptability of interior environments at reduced energy consumption rates and operating cost. Application of these systems will require a specific knowledge of available technology and careful design and construction practice. (DT)

26185 (CONF-811048—Summs., pp 5p, Paper 59) **Performance measurements for residential air-to-air heat exchangers.** Fisk, W.J.; Archer, K.M.; Boonchanta, P.; Hollowell, C.D. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Based on test results presented in this report, a 70 to 80% effectiveness is a reasonable expectation for a residential heat exchanger. The effectiveness of heat exchangers varies significantly, however, and many models have an effectiveness that is less than 70%. The fan power consumption of residential heat exchangers tested by LBL ranges from 0.4 to 4.2 watts per m^3/h of ventilation air. Fan power requirements can be reduced by using efficient fans and fan motors, minimizing the resistance to air flow through heat exchangers and duct systems, and using fan speed instead of damper valves for the control of air-flow rates. (DT)

26186 (CONF-811048—Summs., pp 4p, Paper 60) **Air quality control of ventilation in an office building.** Seppanen, O.; Punttila, A. (EKONO Consulting Engineers, Bellevue, WA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This paper describes the results and experiences of two year operation of the most energy efficient office building in Finland, the EKONO house. The building has several energy conservation features and also the energy consumption of ventilation is minimized. The building is constructed air tight so that measured leakage in winter conditions is only 0.1 to 0.2 air changes per hour. Fresh air rates are low and ventilation is equipped with heat recovery. The building has a direct computer control and extensive performance monitoring system. The building has been operated with CO_2 control of ventilation with several control strategies. At the same time, air quality measurements like CO and particles have been accomplished. Since the building is of concrete construction, concentration of Radon has been monitored in several locations with integrating units and with point measurements. (DT)

26187 (CONF-811048—Summs., pp 4p, Paper 61) **Influence of ventilation on indoor/outdoor air contaminants in an office building.** Berglund, B.; Johansson, I.; Lindvall, T. (Univ. of Stockholm, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

An energy-economized office building (1975 Swedish Building Code) in a trafficked area gives sufficient protection against street pollutants (including odors), provided the location of the air intake and the mixing of air indoors is adequate. The number and concentrations of most air pollutants increased from the air intake along the pathway of the ventilation air. The organic compounds that are generally found outdoors also seem to have indoor sources, however, C_9-alkanes were found almost exclusively in the indoor air. Changes in recirculation air rate changed the concentration of indoor pollutants differently for different compounds. CO_2 and C_9-alkanes increased with increased recirculation air rates, NO decreased and the trend for outdoor organic compounds and CO was somewhere in between. Reduced ventilation by using a demand principle cannot be generally recommended unless the effects of reduced ventilation on other indoor air components than CO_2 have been considered. (DT)

26188 (CONF-811048—Summs., pp 4p, Paper 64) **Realistic tests of an air-to-air heat exchanger.** Persily, A. (Princeton Univ., NJ). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The overall efficiency of the Lossnay model VL-5000 as determined through a heat balance on the Test Chamber is about 50%. If one excludes the energy losses due to heat conduction through the casting and fan power, the heat exchanger efficiency is around 60%, depending on the fan setting. This efficiency is significantly less than the manufacturer's claim of 70%, and the difference is thought to be due to imperfect mixing of air within the Test Chamber. By conducting these experiments with the Lossnay operating in a building we learned about how it would realistically operate in the field. (DT)

26189 (CONF-811048—Summs., pp 5p, Paper 65) **Effects of ventilation on residential air pollution due to emissions from a gas-fired stove.** Traynor, G.W.; Apte, M.G.; Dillworth, J.F.; Hollowell, C.D.; Sterling, E.M. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We investigate the effect of infiltration and two types of mechanical ventilation (whole-house and spot ventilation) on pollutants generated by operation of a gas-fired stove. Carbon monoxide (CO), carbon dioxide (CO_2), nitric oxide (NO), and nitrogen dioxide (NO_2) from three indoor locations (kitchen, living room, and master bedroom) and one outdoor location were measured on a rotating basis. (DT)

26190 (CONF-811048—Summs., pp 4p, Paper 66) **Kitchen range hoods and energy conservation.** Kelso, R.M. (Univ. of Tennessee School of Architecture, Knoxville). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Kitchen cooking equipment ventilation systems are important consumers of energy. Research is needed in filtration methods, safety aspects of recirculation and heat recovery and hood performance. (DT)

26191 (CONF-811048—Summs., pp 4p, Paper 67) **Minimum acceptable infiltration rates for buildings.** Monat, J.P.; Chin, R.H. (Abcor, Inc., Wilmington, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The model developed herein provides a means of calculating the minimum acceptable infiltration rate that maintains adequate indoor air quality while conserving energy. The model may be applied to any specific residence, provided that certain parameters (e.g., house volume, allowable pollutant concerntration) are known. Examples are presented for typical residences and common pollutants, and results are compared with ASHRAE recommended ventilation rates. (DT)

26192 (CONF-811048—Summs., pp 5p, Paper 68) **Calculation of ventilation requirements in the case of intermittent pollution.** Lorenz, F. (Univ. de Liege, Belgium). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The calculation of ventilation requirements for decontamination is well-known and rather simple. In some cases, however, the pollutant emission is intermittent as for example in the car park of an office building, where all the cars enter and leave the place nearly at the same time. Generally, in such a case, the volume of the garage is large, so the time constant has also a high value. So a static approach is no longer accurate and a dynamic evaluation is better applied.

26193 (CONF-811048—Summs., pp 4p, Paper 69) **Ventilation for control of indoor air quality.** Janssen, J.E. (Honeywell Inc., St Paul, MN); Woods, J.E.; Hill, T.J.; Maldinado, E. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

An experiment was carried out in the Music Department Wing of Fridley, Minnesota Junior High School to demonstrate ventilation control based on actual demand. This demand was sensed by the carbon dioxide level in the space. A CO_2 sensor and control system controlled the outdoor air used for ventilation. The subjective response of the students to the reduced ventilation was measured with a specially designed questionnaire. Energy savings were calculated from physical measurements and a system simulation.

26194 (CONF-811048—Summs., pp 4p, Paper 100) **Nordic guidelines for building regulation regarding indoor air quality.** Sundell, J. (National Board of Occupational Safety and Health, Solna, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The guidelines adopted provide a rather ambitious effort to specify requirements in a building code for the indoor climate. It is hoped that they will prove to be useful in designing energy-efficient buildings while maintaining an indoor climate providing acceptable comfort and does not impair human health. Many of the values stated are debatable especially when considering the present state of knowledge.

26195 **(DOE/CE/15095—11) Major energy conservation retrofits. A planning guide for northern climates.** (National Center for Appropriate Technology, Butte, MT (USA)). Mar 1984. Contract AC01-82CE15095. 75p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010632.

Chapter 1 provides the information necessary to help you decide if a major energy retrofit is the right approach to your housing situation. Chapter 2 helps you decide whether to retrofit the inside or the outside of the house and it provides helpful solutions to the potential problems one might encounter once the location has been determined. Chapter 3 compares the various wall, roof, and floor retrofit strategies by cost and insulative value per square foot as well as pointing out the problems inherent in techniques for the exterior and interior and for the masonry and the wood frame structure. Appendix A provides a step-by-step procedure for calculating the cost and insulative value per square foot for an 8-foot-by-8-foot wall section and over 30 tables that use this procedure to show how costs vary when different materials and retrofit techniques are used in the walls, roofs, and floors. Appendix B provides summaries of selective grant projects related to energy conservation and solar retrofits. Appendix C provides a list of sources for more information on energy conservation retrofits.

26196 **(DOE/CS/20286—1) ASEAM: a simplified energy analysis method microcomputer program users manual.** (Fleming (W.S.) and Associates, Inc., Washington, DC (USA)). Jul 1983. Contract AC01-82CE20286. 269p. NTIS, PC A12; 3; GPO Dep. Order Number DE84010671.

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This manual describes the detailed step-by-step procedures required to use a simplified energy analysis method (ASEAM); a microcomputer program developed for the purpose of comparing results predicted by the ASHRAE TC 4.7 procedure with those of the DOE-2.1A hourly simulation computer progrm. ASEAM has been found to track well with energy differences computed by DOE-2 over a range of conditions. ASEAM can be used to examine the energy aspects of alternative building designs using conventional construction and mechanical systems. The program can also be used to evaluate the individual or combined effects of various energy efficient design strategies and is structured to accommodate the most widely used application of energy analysis methods; the comparison of a base case to an alternative. ASEAM is interactive. Its algorithms include heating and cooling load calculations, and HVAC system and plant calculation routines with options to size cooling equipment and air flows. HVAC systems are configured by selecting from and/or combining eight (8) basic system types, control options, five (5) heating plants and five (5) cooling plants. The use of temperature frequency bin data is recommended. In addition to load calculation and HVAC system energy consumption reports, annual estimates for seven (7) energy end use categories are reported. The ASEAM Users Manual includes input forms, input data tables, a Basic language source code listing and description of the algorithms employed.

26197 **(DOE/CS/20411—T1) Health Care Facilities Energy Analysis Study. A report on the development of a manual system to evaluate energy efficiency in health care facilities. Task 5, final report.** (Hammer Consulting Engineers, Inc., Austin, TX (USA)). 23 Apr 1979. Contract AC01-77CS20411. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008917.

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The feasibility of developing a computerized system that could support the preliminary energy audit requirements of Part G of Title III of the National Energy Act, Energy Conservation Programs for Schools and Hospitals Grant Program, as drafted in October 1977 was tested. Results of the system identify energy conservation opportunities in health care facilities and would include no-cost/low-cost operational and maintenance measures and selected capital improvements.

26198 **(DOE/CS/20448—T8) Competitive impact of Building Energy Performance Standards on the lighting and fixtures industries.** (Resource Planning Associates, Inc., Cambridge, MA (USA)). 25 Jun 1979. Contract AC01-78CS20448. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010743.

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The likely effects of BEPS on the overall design of new buildings; how BEPS might affect lighting design and hence, demand for lighting products; and how these changes in demand might affect the competitive structures of the US lamp and fixtures industries are presented. The major elements of a conceptual approach to the effects of regulation on competition are outlined. An analysis of the degree to which BEPS will change the design of new buildings is presented. Although it is concluded that the effect of BEPS on overall building design will be quite small, the same is by no means true for its effect on lighting design. Hence, an approach to estimating the maximum reasonable effect of BEPS on the demand for lighting products is discussed. The potential effect of BEPS on the structure of the lamp and fixtures industries is discussed, based on an analysis of the structure of those industries and the effect of BEPS on demand for lighting products. We concluded that, although the effects of BEPS on the lamp industry will be negligible, more substantial shifts in the structure of the fixtures industry are possible. The elements of an approach that could be generally useful in assessing the impact of new regulations on competition in industries affected by the regulations are outlined.

26199 **(DOE/CS/23977—T1) R.I. Fuel Oil Conservation Marketing Program. Final performance report, 1980-1981.** (Rhode Island Governor's Energy Office, Providence (USA)). Mar 1984. Contract FG01-80CS23977. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008824.

The activities of the Governor's Energy Office under a US DOE grant are summarized briefly. Meetings, advertising details, and efficiency test results are described.

26200 **(DOE/CS/30003—T1) Designing for daylighting. A key to energy performance.** (McGraw-Hill Information Systems, Silver Spring, MD (USA)). 1984. Contract AC01-79CS30003. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010372.

The following aspects of daylighting are discussed: benefits and applicability, sources and fundamentals, siting and building form, space and fenestration layout, integrated lighting design, performance estimation, solar and lighting controls, and additional resources. (MHR)

26201 **(DOE/CS/30003—T2) Energy efficient windows: a key to energy performance.** (McGraw-Hill Information Systems, Silver Spring, MD (USA)). 1984. Contract AC01-79CS30003. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010375.

The following are discussed: design considerations, heat-loss reduction products, comparative data for insulating products, and additional resources. (MHR)

26202 **(DOE/CS/69104—3) Bibliography: wood for fuel.** (Michigan Dept. of Commerce, Lansing (USA)). 1983. Contract FG45-80CS69104. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008913.

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This bibliography contains over 100 citations from magazines on fireplaces, wood-burning stoves, hazards, maintenance, and environmental impacts. (MHR)

26203 **(DOE/R7/01242—T1) Demonstrating the effectiveness of interior storm windows and weatherstripping. Final report.** Wiles, B.; Hoozer, R.V.; Rauch, R.L. (Missouri Univ., Maysville (USA). Extension Center; Northwest Missouri Area Agency on Aging, Inc., Albany (USA)). 21 Dec 1983. Contract FG47-81R701242. 21p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010456.

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Program activities summarized include: home weatherization, weatherization workshops, interior storm window construction, educational information workshops, and publicity. (MHR)

26204 (LBL—13500, pp 3.1-3.3) **Energy Efficient Buildings Program.** Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

A brief overview of the scope and objectives of the following research groups is presented: energy performance of buildings; building ventilation and indoor air quality; building energy simulation; windows, daylighting, and lighting, and buildings energy data. (MHR)

26205 (LBL—13500, pp 3.3-3.11) **Energy performance of buildings (EPB).** Adams, J.W.; Diamond, R.C.; Dickerhoff, D.J.; Dickinson, J.B.; Garnier, J.Y.; Grimsrud, D.T.; Lipschutz, R.D.; Modera, M.P.; Sherman, M.H.; Smith, B.V. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Two primary research areas are air infiltration and wall thermal performance. These studies involve work in the field, in the laboratory, in our research house, and on computer models. A third research area concerns development of an instrumented residential-energy audit that will be field-validated in FY 1982.

26206 (LBL—13500, pp 3.40-3.49) **Energy efficient windows and daylignting.** Selkowitz, S.E.; Berman, S.M.; Johnson, R.L.; Kessel, J.D.; Klems, J.H.; Lampert, C.M.; Rubin, M.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

Progress is reported in three major areas: window performance - analysis and testing; fenetration systems - research, development, and field testing; and daylighting. Included are transparent heat mirrors; optical-shutter materials, selective-reflectance coatings, fenestration optimization studies, and air-flow window systems. (MHR)

26207 (LBL—13500, pp 3.49-3.53) **Lighting systems research.** Verderber, R.R.; Berman, S.M.; Clear, R.D.; Rubinstein, F.M. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

Programs initiated at LBL include development of the solid-state ballast, switching and control systems, and energy-efficient light sources, along with fundamental visibility studies and investigations into the effects of artificial light upon humans.

26208 (LBL—13500, pp 3.54-3.63) **Building energy simulation group.** Hirsch, J.J.; Buhl, W.F.; Curtis, R.B.; Erdem, A.E.; Olson, K.H.; Winkelmann, F.C. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

Research into calculation methodologies relating to building energy use covers the modeling of the building-envelope components and systems. A second area of interest is the simulation of heating, ventilating, and air-conditioning (HVAC) equipment and their associated control systems. (MHR)

26209 (LBL—13500, pp 3.64-3.71) **Buildings energy data group.** Rosenfeld, A.H.; Harris, J.P.; Gardiner, B.L.; Goldman, C.A.; Meier, A.K.; O'Regan, B.C.; Ribot, J.C.; Dross, H.D.; Wagner, B.D.; Usibelli, T.J. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

The work is organized into two main projects and a small effort in primary data collection. The Building Energy Use Compilation and Analysis (BECA) project involves the compilation, critical assessment, and periodic publication of measured data on the energy performance and cost-effectiveness of low-energy new homes (BECA-A), existing retrofitted homes (BECA-B), energy-efficient commercial buildings (BECA-C), and appliances and equipment (BECA-D). A second project maintains and updates a data base on the performance and cost of individual technologies for saving energy in buildings and tracks new technologies as they progress through research, development, field testing, and commercial production. This data base is used often in collaboration with outside organizations, to develop supply curves of conserved energy.

26210 (LBL—16645) **Commercial building energy performance analysis using multiple regression procedures.** Sullivan, R.; Nozaki, S.; Johnson, R.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Oct 1983. Contract AC03-76SF00098. 24p. (CONF-840651—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004239.

From ASHRAE semi-annual conference; Kansas City, MO, USA (24 Jun 1984).

Regression analysis is used to define algebraic expressions which can be used to study the effects of various configuration parameters on building energy performance. The DOE-2.1B energy analysis simulation program was used in conjunction with a prototypical building modules to generate a large data base for five geographic locations. Configuration variables parameterized included orientation, wall and roof conductance, glazing properties of windows and skylights (area, U-value, shading coefficient, visible transmittance, well depth) and installed lighting power. Incremental effects due to external shading (overhangs) and daylighting were also examined. The modular concept used in the building definition permits generalization to configurations other than that analyzed and therefore the results can be used in studying building design tradeoffs.

26211 (NYSERDA—84-2) **Performance contracting for energy efficiency: an introduction with case studies.** (Technical Development Corp., Boston, MA (USA)). Jan 1984. 117p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223.

The report examines how the interests of building owners, contractors, and investors are realized in transactions involving vendor or third-party financing of energy efficiency improvements to commercial, institutional, and residential buildings. The major forms of such transactions are described and their advantages and limitations analyzed from the points of view of each participant. The report is followed by a series of 23 case studies documenting actual performance contracting transactions.

26212 (ORNL/Sub—81-7685/2and92) **TECH House I horizontal coil ground coupled heat pump: 1983 cooling season performance.** Johnson, S.; McGraw, B.A.; Baugh, R.N.; Wix, S.; Conlin, F. (Tennessee Univ., Knoxville (USA). Energy, Environment and Resources Center). May 1984. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012042.

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Performance of the ground-coupled heat pump system in TECH House I at the Tennessee Energy Conservation in Housing Facility is reported for the summer of 1983. The overall seasonal performance factor (SPF) was 1.11 with the system located within the conditioned space. If the system had been outside the conditioned space, an SPF of 1.31 would have been realized. This low performance level, below that of a conventional air-to-air heat pump, is primarily due to poor performance of the ground heat exchanger. Degraded soil heat transfer characteristics due to drying and the occurrence of voids around the pipe in the trench backfill were primary reasons for poor performance. In addition, it appears that the underground coil length needs to be increased in order to match the peak cooling loads of the house. The sensible load on the house was met by the system only for ambient temperature below 98°F. The latent load was often not met because the inside coil temperature was not sufficiently below the dew point temperature of the inside air.

26213 **(PB—84-143817) Proposed simplified methods for predicting thermal behaviour and energy consumption of buildings. Technical memo.** Humphries, M.R.; Saluja, S.N.; Missenden, J.F.; Flynn, D.F. (Polytechnic of the South Bank, London (UK). Inst. of Environmental Science and Technology). Jan 1978. 47p. (TM—72). NTIS, PC E04/MF E04.

The paper which is based on the exhaustive measurements taken to assess the energy requirements and the associated thermal comfort of a large hotel in Scotland shows that while bulk metering can provide an indication of building and system performance, the only reliable way to assess thermal performance is to undertake an energy audit on a microscopic level. Such an audit should be part of a continuous monitoring program and may be used to provide the necessary date from which a simple model of the building may be constructed. From the analysis presented, general laws governing the energy requirements for process, meeting building heat loss and maintaining services, etc. are expressed in simple forms for monitoring purposes.

26214 **(PB—84-151091) Housing standards: change to HUD 4930.2 Intermediate Minimum Property Standard (IMPS) supplement for solar heating and domestic hot water systems.** (Department of Housing and Urban Development, Washington, DC (USA). Office of the Assistant Secretary for Housing-Federal Housing Commission). 17 Aug 1982. 98p. NTIS, PC A05/MF A01.

This rule is made to provide an updating, clarification, and improvement of requirements contained in HUD Handbook 4930.2, Intermediate Minimum Property Standards (IMPS) Supplement concerning solar heating and domestic hot water systems. Changes pertain to fire protection, penetration, roof covering, conditions of use, thermal stability, rain resistance, ultraviolet stability, and compatibility with transfer medium. Additional changes cover applicable standards, labeling, flash point, chemical and physical commpatibility, flame spread classification, lightening protection, and parts of a solar energy system. Altogether, there are over 50 changes, some of which apply to tables and worksheets. Footnotes are included.

26215 **Energy audits as an investment: the residential conservation service program analyzed.** Frankel, M.L.; Duberg, J.A. (Centaur Associates, Inc., Washington, DC). *Public Utilities Fortnightly;* **113**: No. 8, 20-25(12 Apr 1984). Contract AC01-83CE24423.

How effective has the national Residential Conservation Service (RCS) program been in achieving its objectives? Utilities throughout the United States have assumed the responsibilities of offering residential audits, but only negligible energy savings have been recorded. The results of a comprehensive study of the benefits and costs of this particular program are presented. Several key variables are identified which have had a significant impact upon the degree of success achieved regionally and nationally. The authors, cognizant of the limitations of available data, evaluate the relative value of the program to society; consider the perspectives of participants, government, and utilities, and conclude that the effects of the RCS program have been disappointing at best. 2 figures, 1 table

26216 **Energy cost-effectiveness of electric home heating.** Burwell, C.C.; Phung, D.L. (Inst. for Energy Analysis, Oak Ridge, TN). *Public Utilities Fortnightly;* **113**: No. 6, 26-31(15 Mar 1984).

Recent changes in the electricity to natural gas price ratio suggest that the potential market for electric home heating is substantial and improving. The residential customer's choice of home heating alternatives will depend upon total system cost-effectiveness, not simply the engineering rated efficiency of the heating system. The authors distinguish these two concepts and present the results of several studies as evidence of comparative levels of end-use energy consumption for home heating. Their analysis of metered residential usages of electricity and gas suggest an enhanced total effectiveness of electric heating compared to fuel heating. How far into the future the advantage for electricity will persist will depend upon gains in electric heating. 4 references, 2 figures, 1 table.

26217 **Solar Energy Research Institute's daylighting laboratory.** Robbins, C.L.; Hunter, K.C. (Solar Energy Research Inst., Golden, CO). pp 221-222 of 5th Miami international conference on alternative energy sources. Vezirogla, T.N. (ed.). Coral Gables, FL; Univ. of Miami (1983). (CONF-821213—).

From 5. international conference on alternative energy source; Miami Beach, FL, USA (13 Dec 1982).

26218 **RCS index: a comparative guide to the implementation of the Residential Conservation Service Program for the reporting period April 1, 1981 - March 31, 1982 covering 179 utilities and 33 states.** Moulton, D.H.; Cubie, A. Washington, DC; Energy Conservation Coalition (1983). 16p. Energy Conservation Coalition, 1725 I Street, N.W., Suite 601, Washington, DC 20006.

The utilities and states listed in the Residential Conservation Service (RCS) index are ranked according to two criteria for measuring successful RCS audit programs: the cost per audit and the participation rate. The data used to calculate the index were either taken directly or were derived from a summary of utility and state annual reports prepared by the Oak Ridge National Laboratory. Despite variations in the completeness and quality of the data and in the length of time the programs have operated, the index is a useful tool for raising questions and guiding research.

26219 **Thermal conductivity of semitransparent materials.** Fine, H.A. (Univ. of Kentucky, Lexington); Jury, S.H.; McElroy, D.L.; Yarbrough, D.W. pp 359-368 of Thermal conductivity 17. Hust, J.G. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract W-7405-ENG-26.

The three-region approximate solution for coupled conductive and radiative heat transfer and an exact solution for uncoupled conductive and radiative heat transfer in a grey semitransparent medium bounded by infinite parallel isothermal plates are employed to establish the dependence of the apparent thermal conductivity of semitransparent materials on other material properties and boundary conditions. An application of the analyses, which uses apparent thermal conductivity versus density data to predict the dependence of apparent thermal conductivity on temperature is demonstrated. The predictions for seven sets of R-11 fiberglass and rock wool insulations agree with published measured values to within the limits of experimental error (+/-3%). Agreement for three sets of R-19 fiberglass insulations was, however, not good.

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REFER ALSO TO CITATION(S) 26265

26220 **(FRA/ORD—81/73) Low cost catenary design-analysis. Final report, Task 1 and 2.** Retallack, R.L.; Doyle, G.R. Jr.; Schneider, L.A.; Sheadel, J.M. (American Electric Power Service Corp., New York; Battelle Columbus Labs., OH (USA); Ohio Brass Co., Mansfield (USA)). Oct 1981. Contract AI01-79CS50104. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011134.

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A new system of railroad electrification has been studied that requires only a single contact conductor as opposed to the conventional catenary system. Preliminary designs for the various components have been developed and are described. These include the traveller (that rides on the contact conductor), the traveller arm and the supports for the contact conductor. Various dynamic analysis models were developed including a six-degree of freedom model and finite-element model to study the dynamic performance of the total system. Results of the interaction of the components are presented for various contact conductor diameters and tensions, for different span lengths between supports and for various vehicle (traveller) speeds. These results indicate the concept is feasible and the design is viable. Further, the report recommends that the full-scale field test (tasks 3 to 7 inclusive of the contract) be funded to complete the dynamic analysis and to provide a working mechanical model.

26221 (PB—84-144088) EPA (Environmental Protection Agency) evaluation of the HYDRO-VAC device under Section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report. Syria, S.L. (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). Aug 1983. 22p. (EPA-AA-TEB—511-83-12). NTIS, PC A02/MF A01.

This document announces the conclusions of the EPA evaluation of the HYDRO-VAC device under section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the HYDRO-VAC device was conducted upon the application of the manufacturer. The product is claimed to improved fuel economy and performance for both gasoline and diesel fueled vehicles.

26222 (PB—84-145937) EPA evaluation of the VCD supplemental gaseous fuel delivery system under section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report. Barth, E.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Sep 1983. 79p. (EPA-AA-TEB—511-83-13). NTIS, PC A05/MF A01.

This report announces the conclusions of the Environmental Protection Agency (EPA) evaluation of the 'VCD Supplemental Gaseous Fuel Delivery System' under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the 'VCD Supplemental Gaseous Fuel Delivery System' was conducted on the application of the manufacturer. The device is designed to operate the engine of a vehicle on a mixture of gasoline and propane. The device consists of a gaseous fuel metering and control unit, a modified carburetor and associated electrical and plumbing components. It functions by replacing some of the gasoline with propane under certain operating conditions. The device causes the engine to idle on propane, cruise on gasoline, and accelerate on a mixture of the two fuels. This is claimed to be more fuel efficient. This combination of improvements in fuel efficency and fuel substitution is claimed to save both fuel and money.

26223 (PB—84-151174) Transportation energy management. Transit operator facilities. Volume 1. Office guide. (Municipality of Metropolitan Seattle-METRO, WA (USA)). Sep 1982. 44p. NTIS, PC A03/MF A01.

While the bulk of energy expenditures cover vehicle operations, utility costs for fixed facilities have also increased. This report, in two volumes, is intended to assist transit operators assess means of saving money through reducing fixed facility energy usage. Many measures are at no or low cost, whereas others requiring larger investments may be eligible for capital assistance from UMTA. This handbook presents practical, step-by-step instructions for developing and implementing a six-part conservation program. These steps include organizing a conservation team, creating an energy profile, a walk-through survey, implementation procedures, evaluation of measures, and the permanent program. This volume is an office reference guide with instructions for collecting and analyzing the data. Reference material and a case study are included as appendices.

26224 (PB—84-151182) Transportation energy management. Transit operator facilities. Volume 2. Field guide. (Municipality of Metropolitan Seattle-METRO, WA (USA)). Sep 1982. 111p. NTIS, PC A06/MF A01.

While the bulk of energy expenditures cover vehicle operations, utility costs for fixed facilities have also increased. This report, in two volumes, is intended to assist transit operators assess means of saving money through reducing fixed facility energy usage. Many measures are at no or low cost, whereas others requiring larger investments may be eligible for capital assistance from UMTA. This handbook presents practical, step-by-step instructions for developing and implementing a six-part conservation program. These steps include organizing a conservation team, creating an energy profile, a walk-through survey, implementation procedures, evaluation of measures, and the permanent program. This volume includes forms and instructions for collecting and analyzing the data. Reference material and a case study are included as appendices.

26225 (PB—84-153469) Quarterly reports: Railway Technical Research Institute, Volume 24, Number 4, 1983. (Japanese National Railways, Tokyo. Railway Technical Research Inst.). 1983. 47p. NTIS, PC $30.00.

Contents: State of the art of pipe jacking method and its future; Rail potential and countermeasure against potential rise; Estimation of tension from measuring data of contact wire height; Running qualities of bolsterless bogie truck on testing plant; Gas pressure welding of head hardened rail; Examination on results of track performance tests on comprehensive test line of shinkansen; Lateral ballast resistance of operating line; Fabrication of riding quality measuring equipment for track and measurement with it; Fundamental performance and durability of current collection tire; Performance of prototype batteries for diesel cars; Computer program packages for the analysis of linear dynamic systems; Train traffic control system on commuter transportation in major city sphere.

26226 Fuel consumption for road transport in the USA - a comment. Greene, D.L.; Roberts, G.F. (Oak Ridge National Lab., TN). *Energy Economics;* **6**: No. 2, 145-148(Apr 1984). Contract W-7405-ENG-26.

A recent article in this journal (Kouris, Vol. 5, No. 2, April 1983) econometrically estimated the relationship between US car and truck fuel economy and the price of fuel, without considering the effect of legally mandated fuel economy standards for new vehicles. There is considerable evidence that the standards have played an important role in recent fuel economy improvements. An alternative approach to estimating the fuel price responsiveness of new vehicle fuel economy based on vehicle sales data and capital operating cost trade-off analysis of fuel-efficient vehicle design and technology suggests short-and long-run elasticities in the vicinity of 0.25 and 0.5, respectively. Kouris responds that the authors over emphasize the effect of new-car standards and neglect the free market price mechanism. 10 references, 1 figure, 2 tables.

26227 Materials for energy conservation. Schaffhauser, A. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 102-105(Fal 1983).

A major obstacle to achieving greater energy efficiency is the lack of reliable, cost-effective materials for advanced energy conservation systems. Such systems require special materials that permit increased temperatures and pressures and that reduce heat losses, friction, and wear. Energy can also be saved by using lightweight materials and recycling energy-intensive raw materials. The Oak Ridge National Laboratory is responsible for four major research and development programs on materials for the US DOE. These programs covering the major energy-consuming sectors - buildings, industry, and transportation - are described.

26228 Method for assessing the market potential of new energy-saving technologies. Roberts, G.F.; Greene, D.L. (Oak Ridge National Lab., TN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Systems, Man, and Cybernetics;* **13**: No. 1, 30-37(Jan-Feb 1983). Contract W-7405-ENG-26.

An approach for estimating the market potential of new energy-saving technologies is presented. The approach is based on the assumption that consumers implicitly minimize total expected lifetime costs when purchasing new technology. The techniques developed allow simultaneous comparison of any number of competing technologies. An important result of this approach is that technologies can have zero market potential and that these technologies can be identified based solely on technology-specific information, not on attributes of the consumer population. An application of the model is made to the study of market potentials for new automotive technologies.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 25643, 26174, 26174, 26227

26229 (AD-P—002415/8) Status and forecast for supply, demand, and cost of wood adhesives and binders. White, J.T. (Reichhold Chemicals, Inc., Tuscaloosa, AL (USA)). 25 Sep 1980. 8p. NTIS, PC A02/MF A01.

The past and future growth of wood adhesives and binders is summarized in consumption, cost, and availability. The origin of raw materials for wood adhesives and binders is presented with reflections upon U.S.A. and world-wide demand for natural gas and petroleum oil. A forecast is presented for the future supply, demand, and cost of wood adhesives and binders based on up-to-date industry forecasts.

26230 (BMFT-FB-T—83-235) Energy saving processes in the production of flat rolled steel products. Angele, B.; Maid, O. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 39p. (In German). NTIS (US Sales Only), PC A03 MF/A01. Order Number DE84750932.

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On the medium-wide strip mill of the Thyssen AG in Berlin, milling experiments were carried out with the aim to change the quality of hot-rolled steel in such a way that cold-rolled steels or flat products can be substituted. The application of this hot-rolled steel will make some of the next production and/or heat treatment steps unnecessary, so that the substitution will be connected with energy savings. Apart from low-carbon steel coils of ferritic, highly corrosion-resistant micro-alloyed structural steels and dual-phase steels were manufactured. With the successful closing of the experiments, the aim to save energy has been reached, and hot-rolled steel has been made more competitive.

26231 (DOE/ID/12227—T1) Hyperfiltration as an energy conservation technique in the food industry. Phase II. Final report. (National Food Processors Association, Berkeley, CA (USA); Carre, Inc., Seneca, SC (USA)). Apr 1984. Contract FC07-81ID12227. 263p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84010956.

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The continued investigation of various membranes and applications of hyperfiltration in the food industry is reported. Tomato juice was the main emphasis of the study since the potential energy savings for the preconcentration of tomato juice is estimated to be about 23 million liters of oil. There were numerous attempts to produce dynamically formed membranes for concentrating tomato juice. Unfortunately a consistent, reliable membrane was not developed. The thin film composite membrane demonstrated good potential in long term testing of hot tomato juice. The membrane gave consistent results and the flux was able to be restored after cleaning. Hot water from a jar washer and evaporator condensate were investigated for recovery potential. Both show very good potential and the positive results indicate a long term test for approximately 6 months is warranted. Since only feasibility tests were performed, the membrane stability over time needs additional investigation. In addition to tomato juice, several other streams were investigated for concentration potential: orange juice, grape juice, fish stickwater. The concentration of byproducts normally discharged from the plant was also investigated. Primarily short term feasibility tests were performed.

26232 (DOE/ID/12293—T1) Research on an energy-efficient drying process. Interim report, September 24, 1982-November 30, 1983. Ray, R.J. (Bend Research, Inc., OR (USA)). 8 Mar 1984. Contract AC07-82ID12293. 49p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011172.

Phase I of a program to investigate the feasibility of a membrane-based process for the recovery of energy from industrial dryer exhaust streams is covered. A Bend Research asymmetric cellulose acetate membrane was identified as being generally the most suitable membrane available for this application. Laboratory tests in a simulated drying unit demonstrated that a spiral-wound cellulose acetate membrane module is capable of recovering 40% of the water vapor in a 180°F feed stream at 60% relative humidity while producing a permeate stream of 96 mol % water vapor. The water vapor flux through the membrane under these conditions was about 240 x 10^{-4} cm^3 (STP)/cm^2-sec. A technical analysis indicates that this membrane-based process can be used to recover otherwise wasted heat from dryer exhaust streams. Specifically, the analysis shows that the retro-fit of this process to a typical paper dryer results in recovery of 13 times as much energy as is required to operate the necessary vacuum pumps. An economic analysis of this system indicates that, with modest improvement of membrane performance, energy recovery via this process is economically feasible. In addition, this membrane-based energy-recovery process would allow heating capacity to be added to an existing dryer without adding furnace capacity.

26233 (DOE/PR/06010—T33) Advanced sensor development program for the pulp and paper industry. Annual report. (National Bureau of Standards, Washington, DC (USA)). 1984. Contract AI01-76PR06010. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84008548.

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A program is described for the development of measurement science and technology for on-line measurement of process variables in the pulp and paper industry. Four research projects are currently in progress; (1) combustion control sensor, (2) pulp consistency sensor, (3) steam flow sensor, and (4) lignin sensor.

26234 (DOE/R7/01249—T1) Energy conservation using the waste heat from Herreshoff furnace (1982). (Engineering Applications, Inc., Rolla, MO (USA)). 1982. Contract FG47-81R701249. 116p. NTIS, PC A06; 3; GPO Dep. Order Number DE84010434.

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This report evaluates the feasibility of power generation as a by-product to charcoal production process by means of utilizing the produced waste gas. Furthermore, for the purpose of conducting this study, the power generation is defined as the simultaneous production of electrical power and a useful form of thermal energy, such as steam. For this specific application the electricity is considered to be the needed product and the steam is treated as the by-product. The study showed that all the proposed alternatives are feasible, resulting in the payback period within the life of the system. For the case of Herreshoff in Garnett Wood Products, a combination of a waste heat boiler and an induction steam turbine generator with 4.2 year payback appears to be the most economical alternative. However, based on the technical evaluation of the proposed systems, the indirect turbine generator with 6 year payback period was found to be the most feasible technology.

26235 (DOE/RA/50278—1) COSTEAM: an industrial steam generation cost model. Phase III. Users' guide and model description. Reierson, J.; Hughitt, E. (Mitre Corp., McLean, VA (USA). METREK Div.). Nov 1981. Contract AC01-80RA50278. 377p. (MTR—81-W-259). NTIS, PC A17; 3; GPO Dep. Order Number DE84008672.

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COSTEAM is an interactive computer model for estimating capital and operating costs for industrial steam produced by the following steam plant technologies: conventional coal-fired boiler plant with environmental control systems, coal-fired atmospheric fluidized bed boiler, oil-fired boiler, gas-fired boiler and coal-oil mixture retrofit to an oil-fired boiler. In addition, costs are estimated for cogeneration, steam distribution and the demolition of an existing plant. This report contains a Users' Manual and a description of the COSTEAM model. Appendices include a dictionary of COSTEAM parameters, sample output, the capital cost data base and information useful for installing and maintaining the model.

26236 (N—8410503) A simple mathematical model for heat transfer and its application for continuous type reheating furnaces. Klima, R.; Kuck, A.; Sucke, D. (British Gas Corp., London). Jul 1983. 18p. NTIS, PC A02/MF A01.

Translated from Gas Waerme Intern. (Netherlands), 32: No. 4, 138-143(Apr 1983). Presented at the 15th meeting of the Oil Panel, 13th meeting, 14th meeting of the Heat Transfer Panel, and the 29th meeting of the Aerodynamic Panel, Velsen, Netherlands, 27-29 Oct 1981.

The requirements that must be met by mathematical models for the process control of continuous-type reheating furnaces are outlined. A description is given of heat transfer in reheating furnaces is computed using simple models. A comparison of computed figures with measured values shows the accuracy of description attainable with such models for stationary and non-stationary operation. The mathematical models are fully equal to their task of replacing measuring points in the proess control of reheating furnaces in on-line operation. Since similar conceptual models were applied for the forecasting models designed to determine energetically optimum control parameters for the future, a high degree of accuracy of description is also expected for these elements. Commercial-scale testing and use of the complete program system for the process control of continuous-type reheating furnaces in on-line operation is under way.

26237 **Extraction of trace metals from fly ash.** Blander, M.; Wai, C.M.; Nagy, Z. (to Dept. of Energy). US Patent Application 6-523,492. 15 Aug 1983. 11p. Contract W-31-109-ENG-38.

A process is described for recovering silver, gallium and/or other trace metals from a fine grained industrial fly ash associated with a process for producing phosphorous. The fly ash has a silicate base and contains surface deposits of the trace metals as oxides, chlorides or the like. The process is carried out by contacting the fly ash with $AlCl_3$ in an alkali halide melt to react the trace metals with the $AlCl_3$ to form compositions soluble in the melt and a residue containing the silicate and aluminum oxide or other aluminum precipitate, and separating the desired trace metal or metals from the melt by electrolysis or other separation techniques.

26238 **Microprocessor-based data acquisition system for an experimental biomass-fired corn dryer.** Aurand, J.F.; Anderson, M.E.; Bern, C.J. (Agricultural Engineering Department, Iowa State University, Ames, Iowa). *ASAE (American Society of Agricultural Engineers) Technical Paper;* **83-3032**: 15(Jun 1983). (CONF-8306126—).

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

A data acquisition system was designed and built for temperature measurements in an experimental furnace and dryer. It uses a SYM-1 microcomputer and will handle up to 35 thermocouple sensors. Data are recorded on cassette tape for later analysis, and a digital display is provided for in-field monitoring. The system is easily adaptable for other data-collection requirements.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 25874, 26178, 26180, 26215, 26216

26239 (ANL—83-55, pp 85-88) **Energy from Municipal Waste Program.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The United States annually generates more than 135 million tons of municipal solid waste, the disposal of which is a rapidly growing problem for many areas of the country where traditional methods of landfill and uncontrolled incineration are becoming too expensive or environmentally unacceptable. Argonne National Laboratory is the lead laboratory for DOE's Energy from Municipal Waste Program. The philosophy of the program is to undertake research activities that enhance the ability for the private sector to complete the development, demonstration, and commercialization of MSW technologies. The following five thermal conversion technologies were assessed: (1) large-scale mass burners, (2) small-scale modular mass burners, (3) dedicated combustors of refuse-derived fuel, (4) pyrolysis reactors, and (5) fluidized-bed combustors. The operating history, the emission control technologies employed, and the available emission monitoring data for MSW combustors have been collected by surveying combustor operators. The information was compiled for seven different types of commercial MSW combustors: (1) large-scale mass burners, (2) small-scale modular mass burners, (3) dedicated RDF combustors, (4) cofired RDF combustors, (5) fluidized-bed RDF combustors, (6) pyrolyzers, and (7) unknown or unclassified combustors. The extent to which stack monitoring has been done is summarized.

26240 (ANL/CNSV-TM—120-Vol.6) **Thermal systems for conversion of municipal solid waste. Volume 6. Fluidized-bed combustion: a technology status report.** Trezek, G.J. (California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Jan 1983. Contract W-31-109-ENG-38. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011440.

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The Western Lake Superior Sanitary District's wastewater-treatment and sludge-disposal facility at Duluth, Minnesota, is the only commercial-scale plant that burns municipal solid waste in a fluidized bed. This facility has experienced a number of operational problems connected with refuse processing, refuse-derived-fuel and sludge feeding, fuel quality, and product disposal. The Duluth system and its problems are discussed, and systems treating other types of waste (such as sludges, wood waste, and tires) are also considered. System operational problems notwithstanding, economic projections indicate that fluidized-bed combustion is a feasible alternative for municipal-solid-waste treatment. Codisposal of refuse-derived fuels and sludges also appears economically attractive. Numerous R and D requirements that could lead to improved technical performance for these systems have been identified. Areas in which further R and D efforts should prove beneficial include fuel preparation, feed-port location and number, internal-geometry optimization, bed performance, and air-emission evaluation. Also, design models adequate to determine proper unit scaling are needed.

26241 (BMFT-FB-T—83-252) **Low-temperature district heat Voerde. Generation, transport and use of low-temperature waste heat.** Bartsch, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 116p. (In German). NTIS (US Sales Only), PC A06 MF/A01. Order Number DE84750942.

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In the town of Voerde, 'Fernwaermeversorgung Niederrhein GmbH' (a private company limited concerned with district-heat supply) operates several gas or oil-fired block heating stations. The purpose of the research project named 'Niedertemperatur Fernwaerme Voerde' ('Low-temperature district-heat, Voerde') was to find out whether it is economically and technically possible to bring the waste heat (which is obtained in the low-temperature range as a by-product in power plants and industrial enterprises), after its being transported over long distances, as well as heat pumps to the required temperature level. As is shown in the following report, it is in fact possible, under the technical and economical aspect, to transport the low-temperature waste heat (which is produced in Voerde heating station) at a maximum outgoing temperature of 35°C from there, over a transportaion line having a length of 3 km, to the major points of supply and to bring it to the required temperature level by means of compression-type heat pumps, there. The research project was not realized because evidence has been made that the connection provided between Voerde supply area and 'Fernwaermeschiene Niederrhein' will be more efficient economically.

26242 (BMFT-FB-T—83-274) **Heating stations with heat pumps.** Ceelen, D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 193p. (In German). NTIS (US Sales Only), PC A09 MF/A01. Order Number DE84750943.

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Heating stations with heat pumps for district-heating can be considered as an alternative to conventional heating stations and heating power stations. The economical and heat engineering aspects of five different circuit variants are being investigated and compared with competing methods. Heating plants with refrigerating medium heat pumps are situated at the break-even point and

have very good prospects to gain ground on the energy market with the upward tendency of the fuel prices.

26243 **(CONF-840283—1) Pyrolysis of MSW: the current ANL/DOE program.** Helt, J.E.; Henry, R.F.; Young, J.E. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010520.

From Workshop on energy from municipal waste research; Argonne, IL, USA (22 Feb 1984).

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Pyrolysis of MSW is a promising method of producing useful fuels. However, several large-scale pyrolysis plants have not performed as expected, producing low yields of inferior products. Reasons for these shortcomings include a lack of understanding of the fundamental mechanisms and kinetics. Current DOE-sponsored research is directed at improved understanding of the basic thermokinetic mechanisms associated with pyrolytic converison of MSW. This work is directed not only at conventional pyrolysis, but also at the potential for product upgrading and advanced liquefaction concepts.

26244 **(DOE/CS/20074—T2) City of Red Wing, district heating study.** (Touche Ross and Co., Minneapolis, MN (USA); Henningson, Durham and Richardson, Minneapolis, MN (USA)). Sep 1983. Contract AC02-78CS20074. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010367.

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The activities and results of the Phase II system analysis and preliminary design are summarized as follows: market assessment, technical assessment, business plan overview, system economic analysis, and end user eonomic analysis. (MHR)

26245 **(DOE/CS/20074—T3) Red Wing district heating project. Phase II. Preliminary design and economic analysis report.** (Touche Ross and Co., Minneapolis, MN (USA); Henningson, Durham and Richardson, Minneapolis, MN (USA)). Jan 1983. Contract AC02-78CS20074. 121p. NTIS, PC A06; 3; GPO Dep. Order Number DE84010371.

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The activities and results of the Phase II system analysis and preliminary design are reported. The following are included: market survey and end user analysis; preliminary system cost and design; and business plan, economic analysis, and rate structure. (MHR)

26246 **(DOE/CS/20233—T1) Bi-State Development Agency resource recovery project. Phase II report.** (Bi-State Development Agency, St. Louis, MO (USA)). 30 Jun 1982. Contract FG01-79CS20233. 161p. NTIS, PC A08; 3; GPO Dep. Order Number DE84010865.

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The system concept and structure for the steam loop project to be implemented were modified. As currently defined, this project will comprise a 600-TPD waste-fired facility (with supplemental oil- or gas-fired package boilers) selling steam to the City of St. Louis, who will purchase the steam loop from UE. The concept for the RDF project has remained the same as when originally selected for implementation. Phase II project activities are summarized by the following major task areas as delineated in the Phase II Scope of Work: Waste Verificiation and Control; Energy and Materials Market Development and Negotiations; Steam Loop Evaluation; Final Site and System Selection; Environmental Impact Assessment; Economic and Financial Analysis; Project Structure; Procurement Documents Preparation and Issue; Contractor Selection and Negotiation; and Project Management.

26247 **(DOE/ER/10691—T1) Modification of the surface temperature by an artificial cirrus cloud. Final report, September 1, 1980-November 30, 1983.** Chylek, P.; Vonnegut, B. (State Univ. of New York, Albany (USA). Research Foundation). Dec 1983. Contract AC02-80ER10691. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011387.

We have investigated the idea that clouds may be stimulated to form artificially to modify the diurnal variation of temperature near the ground. Cloudiness can be created or increased by dispersing ice-nucleating agents in clear, ice-supersaturated regions of the atmosphere (clear-air seeding). Possible applications of this technique are the reduction of energy required for daytime air conditioning and nighttime space heating in heavily populated areas. The outcome of these investigations can be summarized as follows: (1) the clouds expected to be produced by operational clear-air seeding will have a significant impact on the radiation balance near the ground; (2) clouds can probably be created more efficiently by deliberate seeding in clear air than they are during inadvertent contrail formation; (3) the opportunities each winter for clear-air seeding have been estimated to be about 7 periods of several-hour duration at any single location in the northeastern United States; (4) during winter nights, clear-air seeding to reduce residential heating requirements would be economically worthwhile in densely populated areas of the northeastern United States; (5) based on estimates of the occurrence of clear, ice-supersaturated air in the upper troposphere only, opportunities for clear-air seeding in daytime to reduce air conditioning expense would occur several times a month.

26248 **(DOE/ID/12243—T1) Replacement of chemical intensive water treatment processes with energy saving membrane. Final report.** Mickley, M.C.; Goering, S.W. (Coury and Associates, Lakewood, CO (USA)). Nov 1983. Contract FC07-83ID12243. 73p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011028.

The project investigated the use of charged ultrafiltration membranes to treat hard water. More specifically, the work was undertaken to (1) make charged ultrafiltration membranes to demonstrate the technical feasibility of the chemical grafting approach; (2) evaluate the market potential for charged ultrafiltration membranes; and (3) evaluate the cost and energy savings for using charged ultrafiltration as compared to lime-based clarification and other treatment methods. The results suggest that chemical grafting is a relatively simple, reproducible and low-cost way to modify existing substrate materials to give them enhanced transport performance. Process studies lead to the identification of good market potential for membrane processes using charged ultrafiltration membranes. Capital and operating costs relative to lime-based clarification are favorable for low- and medium-sized treatment plants. Finally, substantial energy savings are apparent as compared to lime-based precipitation systems which incur substantial energy consumption in the lime production and transportation steps.

26249 **(DOE/R5/10161—2) Heat pump performance: Sun Prairie Wastewater Treatment Facilities.** (Strand Associates, Inc., Madison, WI (USA)). Jun 1983. Contract FG02-79R510161. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011209.

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The performance of the heat pump installed at the Sun Prairie Waste Treatment Plant is summarized. Data presented in this report are from November 1982 to April 1983. These represent information for the 1982 to 1983 heating season. In addition to information on performance, a brief description of the treatment plant and the heating system are provided. Finally, a cost comparison of the heat pump and alternative fuel sources is also included.

26250 **(NP—4770240) Contribution of new combined heat and power generation plants to electricity supply.** (Basler und Hofmann, Ingenieure und Planer A.G., Zurich (Switzerland); Sulzer Consulting, Winterthur (Switzerland)). 1980. 47p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84770240.

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In a first phase, the technical principles are elaborated and the technical (theoretical) potential of electric power generation from combined heat and power generation plants is evaluated. Starting from this technically possible field of application, a second phase is evaluated which shall show for which share the combined heat and power generation plants are economical (economic potential). The third phase eventually had to answer the question which share of the economic potential can actually be realized by 1990 (realizable potential) and how large the contribution of new com-

bined heat and power generation plants to electricity supplies shall be in Switzerland.

26251 (ORNL/Sub—7698/1) Environmental regulatory requirements of hot water district heating systems in the Minneapolis-St. Paul metropolitan area. Cole, K.R.; Kinnear, D.L.; Heiting, G.J. (Oak Ridge National Lab., TN (USA); Minnesota Energy Agency, St. Paul (USA)). May 1984. Contract AC05-84OR21400. 214p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84011151.

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A study was made of the environmental regulatory requirements for implementing district heating/cogeneration in the Minneapolis - St. Paul Twin Cities area. Two district heating scenarios were assumed: (1) a 200 MW(t) hot water system using an existing power plant as a heat source to serve the St. Paul central business district and the Capitol complex area; and (2) a regional 2600 MW(t) hot water system using existing power plants plus one new cogeneration unit to serve a large portion of the Twin Cities metropolitan area. All required environmental permits and authorizations were profiled and a flowchart was prepared to illustrate each process. Timelines were developed showing typical sequences of permitting and construction. The cost of compliance was estimated and overall application strategies were recommended. Suggested modifications to the regulatory process were also developed. 10 references, 40 figures, 1 table.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 25625, 26264

26252 (LBL—13500, pp 4.82-4.83) **Lean engine combustion studies.** Sawyer, R.F.; Oppenheim, A.K.; Daily, J.W.; Greif, D.R.; Hom, K.; Stewart, H.E.; Woodard, J.B.; Hirvo, D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Studies of important phenomena relating to lean combustion have been conducted utilizing unique single-pulse, compression-expansion facilities, which feature square pistons and two glass walls, provide complete optical access to the combustion process, including that part which occurs as the piston is withdrawn. Preliminary investigations have been conducted of the opticalmeasurement of hydrocarbons using in-situ optical-absorption methods. (LEW)

26253 (N—8410581) Advanced Gas Turbine (AGT): Power-train system development. Helms, H.E.; Johnson, R.A.; Gibson, R.K.; Smith, L.B. (Detroit Diesel Allison, Indianapolis, IN (USA)). Aug 1983. 64p. (NASA-CR—168056; DOE/NASA—0168-5). NTIS, PC A04/MF A01.

Technical work on the design and effort leading to the testing of a 74.5 kW (100 hp) automotive gas turbine is described. The general effort was concentrated on building an engine for test starting in July. The buildup progressed with only routine problems and the engine was delivered to the test stand 9 July. In addition to the engine build effort, work continued in selected component areas. Ceramic turbine parts were built and tested. Burst tests of ceramic rotors show strengths are approaching that achieved in test bars. Proof testing is required for acceptable strength ceramic vanes. Over 25 hours was accumulated on the combustor rig in three test modes: pilot nozzle only, start nozzle, and main nozzle operation. Satisfactory ignition was achieved for a wide range of starting speeds and the lean blowout limit was as low as 0.06 kg/b (0.14 lb/hr). Lean blowout was more a function of nozzle atomization than fuel/air ratio. A variety of cycle points were tested. Transition from start nozzle flow to main nozzle flow was done manually without difficulty. Regenerator parts were qualification tested without incident and the parts were assembled on schedule. Rig based performance matched first build requirements. Repeated failures in the harmonic drive gearbox during rig testing resulted in that concept being abandoned for an alternate scheme.

26254 (NZERDC-P—80) Effects of varying gas composition on the performance of CNG fuelled vehicles. Jones, K.; Raine, R.R. (New Zealand Energy Research and Development Committee, Auckland). Dec 1983. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84900969.

A theoretical study has been made of the relationships between natural gas composition and vehicle power, tune condition, fuel consumption and range. Results are presented for five gas compositions that are either currently available in New Zealand or could be in the future. These are: treated Kapuni, Maui (D and C sands) and gases with the gas liquids either wholly or partially removed. The study indicates that with optimized engine tuning the full throttle power output for the various gases should not differ by more than 2%. Fuel consumption rates, compared with Kapuni, would be 11% higher with Maui D, 8% higher with Maui C, 8% higher with a partially stripped gas and 12% higher with a fully stripped gas. Vehicle range, assuming a constant storage cylinder size and filling pressure, compared with Kapuni, would be 6% less with Maui D, 9% less with Maui C, 16% less with a partially stripped gas and 22% less with a fully stripped gas. Practical power and fuel consumption tests have been conducted on two vehicles using Kapuni and Maui (D) gases. Results confirm the prediction that, with optimum engine tuning, there should be no perceptible difference in the full throttle power between the gases. Fuel consumption results have indicated that the relative consumption rates of the various gases may vary significantly as a result of individual engine design and CNG conversion system performance differences.

26255 (PB—84-148543) EPA (Environmental Protection Agency) evaluation of the POWERFuel Extender System under Section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report. Syria, S.L. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1983. 49p. (EPA-AA-TEB—511-83-7). NTIS, PC A03/MF A01.

The evaluation of the POWERFuel Extender System was conducted upon the application of the manufacturer. The device is claimed to improve fuel economy and driveability and to reduce exhaust emissions and required engine maintenance. The device is classified by EPA as a vapor-air bleed device. EPA fully considered all of the information submitted by the applicant. The evaluation of the POWERFuel Extender System was based on that information and on EPA's experience with other similar devices. Although, in theory, the introduction of alcohol and water could have a favorable effect on an engine's cleaniness, power and maintenance requirements and could even allow some vehicles to use lower octane fuel, data were not submitted to substantiate that the POWERFuel Extender System could cause these benefits.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 26076

26256 (DOE/NASA—0189-83/2) Study and review of permanent magnets for electric vehicle propulsion motors. Strnat, K. (Dayton Univ., OH (USA). Dept. of Electric Engineering). Sep 1983. Contract AI01-77CS51044. 177p. (NASA-CR—168178). NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84011322.

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A study of permanent magnets (PM) was performed in support of the DOE/NASA electric and hybrid vehicle program. PM requirements for electric propulsion motors are analyzed, design principles and relevant properties of magnets are discussed. Available PM types are reviewed. For the needed high-grade magnets, design data, commercial varieties and sources are tabulated, based on a survey of vendors. Economic factors such as raw material availability, production capacity and cost are analyzed, especially for cobalt and the rare earths. Extruded Mn-Al-C magnets from Japan were experimentally characterized. Dynamic magnetic data for the range -50° to +150°C and some mechanical properties are reported. The state of development of the important PM material

families is reviewed. Feasible improvements or new developments of magnets for electric vehicle motors are identified.

26257 **(DOE/NASA/0249—83/1) Integral inverter/battery charger for use in electric vehicles. Final report.** Thimmesch, D. (Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.-Electrical and Electronic Research). Sep 1983. Contract AI01-77CS51044. 143p. (NASA-CR—168177). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010642.

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The design and test results of a thyristor based inverter/charger are discussed. A battery charger is included integral to the inverter by using a subset of the inverter power circuit components. The resulting charger provides electrical isolation between the vehicle propulsion battery and ac line and is capable of charging a 25 kWh propulsion battery in 8 hours from a 220 volt ac line. The integral charger employs the inverter commutation components as a resonant ac/dc isolated converter rated at 3.6 kW. Charger efficiency and power factor at an output power of 3.6 kW are 86% and 95%, respectively. The inverter, when operated with a matching polyphase ac induction motor and nominal 132 volt propulsion battery, can provide a peak shaft power of 34 kW (45 hp) during motoring operation and 45 kW (60 hp) during regeneration. Thyristors are employed for the inverter power switching devices and are arranged in an input-commutated topology. This configuration requires only two thyristors to commutate the six main inverter thyristors. Inverter efficiency during motoring operation at motor shaft speeds above 450 rad/sec (4300 rpm) is 92 to 94% for output power levels above 11 KW (15 hp). The combined ac inverter/charger package weighs 47 kg (103 lbs).

26258 **(PB—84-144674) Electrical vehicle refueling infrastructure. Final report.** Baker, M. (Open Univ., Milton Keynes (UK). Energy Research Group). Oct 1981. 71p. NTIS, PC E04/MF E04.

The Vehicle Refueling Infrastructure (VRI) study derived from a larger project entitled Future Transport Fuels study and concentrated on two aspects of this problem: refueling mechanisms; and the implications in terms of changes to the electricity system as opposed to changes in the liquid fuel manufacturing process. Two transport scenarios were analysed: an all electric road vehicle fleet and an all liquid fueled fleet. The pathway from primary energy to transport output was assessed. Among the topics considered were: vehicle design, transport and projections, an analysis of journeys, in situ recharging requirements, battery exchange stations, liquid fueled stations, UK primary energy supplies, fuel allocations, the electricity system and fuel costs (per vehicle and for primary energy sources). The author concluded that the electric vehicle scenario required a smaller installed electricity generating capacity and was more feasible. Further research was suggested on: range requirements; a computer model; and the development of a cheap and simple 40 amp plug and socket and solid state recharger.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 26256

26259 **(AD-A—136950/3) Hybrid vehicle simulation. Master's thesis.** Founds, D.B. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). 17 Oct 1983. 74p. (AFIT/GAE/AA—81D-8). NTIS, PC A04/MF A01.

Interest in nonpetroleum fueled ground vehicles led Stafford to develop the computer code, Electric Vehicle Simulation (EVSIM). EVSIM was designed to predict the performance of current electric vehicles or to be used in the design of electric/hybrid vehicles. Before EVSIM could be used, it needed to be verified by comparing its predictions to the results of a vehicle test. It was also desired to improve the code's ability to model several types of Internal Combustion Engines that may be used in hybrid vehicles. The approach taken was to test the components of the hybrid vehicle separately prior to testing the whole vehicle. This was done to verify separate sections of EVSIM prior to a systems run. The results of these comparisons and the system comparison are included with recommended changes to EVSIM.

3306 Vehicle Design Factors

26260 **(PB—84-143577) EPA (Environmental Protection Agency) evaluation of the gyroscopic wheel cover device under Section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report.** Syria, S.L. (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). Jun 1983. 61p. (EPA-AA-TEB—511-83-11). NTIS, PC A04/MF A01.

This report announces the conclusions of the Environmental Protection Agency (EPA) evaluation of the Gyroscopic Wheel Cover under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the Gyroscopic Wheel Cover device was conducted upon the application of Simmer Wheels, Incorporated. The device is a mechanical assembly which replaces each of the standard wheel covers on a vehicle. The device is claimed to improve fuel economy, handling and braking characteristics, and the life of the brakes and tires.

3307 Emission Control

REFER ALSO TO CITATION(S) 26255

26261 **(PB—84-146166) EPA (Environmental Protection Agency) evaluation of the P.S.C.U. 01 device under section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report.** Syria, S.L. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1983. 52p. (EPA-AA-TEB—511-83-6). NTIS, PC A04.

This document announces the conclusions of the EPA evaluation of the 'P.S.C.U. 01' device under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the P.S.C.U. 01 was conducted upon the application of Dutch Pacific, Incorporated. The device is comprised of several mechanical and electrical components and is intended to generate steam and deliver it to the combustion chamber via an inline catalyst. The device is claimed to improve fuel economy and to reduce exhaust emissions. The P.S.C.U. 01 is classified by EPA as a Vapor bleed device.

26262 **(PB—84-148014) EPA (Environmental Protection Agency) evaluation of the Mesco Moisture Extraction System under Section 511 of the Motor Vehicle Information and Cost Savings Act. Technical report.** Barth, E.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jul 1983. 74p. (EPA-AA-TEB—511-83-10). NTIS, PC A04/MF A01.

This document announces the conclusions of the EPA evaluation of the Mesco Moisture Extraction System device under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the Mesco Moisture Extraction System was conducted upon the application of the manufacturer. The device is an exhaust gas recirculation (EGR) system. The device supplements the EGR system of a vehicle by adding cooled and filtered exhaust gas to the carburetor. The ignition timing is also advanced. This combination of advanced timing and supplemental EGR is claimed to result in a longer cleaner burn that improves engine performance and reduces emissions.

3308 Alternative Fuels

26263 **(SERI/TP—232-2240) Testing of a small combustion turbine burning reformed methanol.** Karpuk, M.E.; Schell, D.J. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1984. Contract AC02-83CH10093. 8p. (CONF-840543—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84000100.

From International symposium on alcohol fuels technology; Ottawa, Ontario, Canada (21 May 1984).

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As part of ongoing research into high-efficiency alcohol fuels utilization at the Solar Energy Research Institute, as gas combustion turbine was modified for use with reformed methanol and tested. The reforming process for this application uses waste engine heat to convert methanol and steam in the presence of a catalyst into hydrogen and carbon dioxide. We modified the standard combustor of a Garrett Model GTCP85-397 combustion turbine to burn the hydrogen and carbon dioxide mixture. Heat exchangers to boil and reform a methanol and water mixture were sized, purchased, and connected to the turbine exhaust. Instrumentation was added to monitor turbine temperatures, pressures, and exhaust emissions. Turbine performance and emissions were measured at various loads with a distillate fuel and compared with performance on reformed methanol. Reformed alcohol yields a significant improvement in efficiency because waste heat is reclaimed as chemical energy in the fuel. The larger mass flowrate of fuel to the combustor increases power output, and emissions are substantially reduced. 5 references, 6 figures, 4 tables.

26264 **(WAOENG—83-24) Local government energy management: liquid petroleum gas (LPG) as a motor vehicle fuel.** McCoy, G.A.; Kerstetter, J. (Washington State Energy Office, Olympia (USA)). Oct 1983. Contract FG06-79R000003. 50p. (WS-LGTA—83-10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010474.

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The retrofit or conversion of automotive engines to operate on liquid petroleum gas (LPG) or propane fuel is one of many potentially cost-effective strategies for reducing a local government's annual fleet operating and maintenance costs. The cost effectiveness of an LPG conversion decision is highly dependent on the initial conversion cost, vehicle type, current and projected fuel costs, vehicle fuel economy (miles per gallon), and yearly average mileage. A series of plots have been developed which indicate simple paybacks for the conversion of several vehicle types (passenger car, small and standard pickups, and two and three ton trucks) over a wide range of fuel economies and annual usage patterns. A simple payback of less than three years can be achieved for vehicles with poor fuel economy and high annual use. The figures provided in this report may be used by fleet management personnel as a screening tool to identify those passenger cars, small or standard pickups, or light duty trucks which are candidates for LPG conversion. In addition to examining the benefits of an LPG conversion, local governments should also consider the competing energy management strategies of downsizing, and the acquisition of fuel efficient, diesel powered vehicles.

26265 **(WAOENG—83-48) Cost effectiveness of converting to alternative motor vehicle fuels. A technical assistance study for the City of Longview.** McCoy, G.A. (Washington State Energy Office, Olympia (USA)). 18 Nov 1983. Contract FG06-79R000003. 64p. (WS-LGTA—83-12). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010479.

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The City of Longview can obtain significant fuel savings benefits by converting a portion of their vehicle fleet to operate on either compressed natural gas (CNG) or liquid petroleum gas (LPG) fuels. The conversion of 41 vehicles including police units, sedans, pickups, and light duty trucks to CNG use would offset approximately 47% of the city's 1982 gasoline consumption. The CNG conversion capital outlay of $115,000 would be recovered through fuel cost reductions. The Cascade Natural Gas Corporation sells natural gas under an interruptible tariff for $0.505 per therm, equivalent to slightly less than one gallon of gasoline. The city currently purchases unleaded gasoline at $1.115 per gallon. A payback analysis indicates that 39.6 months are required for the CNG fuel savings benefits to offset the initial or first costs of the conversion. The conversion of fleet vehicles to liquid petroleum gas (LPG) or propane produces comparable savings in vehicle operating costs. The conversion of 59 vehicles including police units, pickup and one ton trucks, street sweepers, and five cubic yard dump trucks would cost approximately $59,900. The annual purchase of 107,000 gallons of propane would offset the consumption of 96,300 gallons of gasoline, or approximately 67% of the city's 1982 usage. Propane is currently retailing for $0.68 to $0.74 per gallon. A payback analysis indicates that 27.7 months are required for the fuel savings benefits to offset the initial LPG conversion costs.

26266 **Methanol as an automotive fuel. Staff Report prepared by the Subcommittee on Fossil and Synthetic Fuels, U.S. House of Representatives, Ninety-Eighth Congress, 2d Session, Feb 1984.** Washington, DC; Government Printing Office (1984). 197p.

The House staff report concludes that methanol produced from domestic coal, gas, and other sources has the potential to displace a significant portion of US gasoline consumption. Using a coal-based transportation fuel would improve energy security and the balance of payments by displacing imported oil. It would stimulate the coal industry, increasing employment and providing a market for certain types of coal for which future markets are uncertain. Methanol fuels would reduce air pollution, and would be economical if world oil prices rise faster than coal prices. Market forces alone will delay the transition, however, suggesting a government role in research, regulatory changes, and temporary market incentives. The government should also try to assure that the demand for fuel methanol will be met with a product made from domestic coal. 38 references, 8 figures.

36 MATERIALS

REFER ALSO TO CITATION(S) 26537

26267 (DL/SCI/R—19, pp 1-10) **Techniques for materials research with synchrotron radiation x-rays.** Bowen, D.K. (Warwick Univ., Coventry (UK). Dept. of Engineering). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

A brief introductory survey is presented of the properties and generation of synchrotron radiation and the main techniques developed so far for its application to materials problems. Headings are:synchrotron radiation; X-ray techniques in synchrotron radiation (powder diffraction; X-ray scattering; EXAFS (Extended X-ray Absorption Fine Structure); X-ray fluorescent analysis; microradiography; white radiation topography; double crystal topography); future developments.

26268 **(LBL—16983) Molecular ingredients of heterogeneous catalysis.** Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 56p. (CONF-8311151—1). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010707.

From Royal Society of Chemistry international congress on catalysis; London, UK (7 Nov 1983).

Recent developments of the molecular science of heterogeneous catalysis is reviewed from the surface science side. The investigations utilize mostly small area single crystal catalysts and use the full repertoire of surface science techniques for their characterization. The most frequently used tools for surface characterization include low energy electron diffraction (LEED), Auger electron spectroscopy (AES), and high resolution electron energy loss spectroscopy (HREELS). The work horse for the catalytic studies was the low-pressure, high-pressure apparatus. When using model catalysts it is essential to establish if close similarity exists between the behavior of the model and the real catalyst systems. This was found to be the case for several reactions that include the hydrogenation of carbon monoxide over rhodium, the hydrogenation of cyclohexene and the ring opening of cyclopropane. The investigation of several important catalytic reactions included the conversion of hydrocarbons over Pt crystal surfaces, the synthesis of ammonia over iron and rhenium crystals, the hydrogenation of carbon monoxide over iron and rhodium, and the photodissociation of water over TiO_2, $SrTiO_3$ and iron oxides. From these studies three molecular ingredients of heterogeneous catalysis were identified: the atomic structure of the surface, the carbonaceous deposit, and the oxidation state of surface atoms.

26269 (UCRL—15599) Growth and characterization of metal oxide whiskers for aerosol filtration. Brewer, J.M. (California Univ., Berkeley (USA)). 6 Jul 1984. Contract W-7405-ENG-48. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011049.

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When grown on a phosphor bronze screen, copper oxide whiskers enhance the capture efficiency due to inertial impaction by orders of magnitude, particularly for small aerosols (D/sub p/ ≅ 1.0 μm) at low flow rates (U ≅ 1.0 m/s). The increased pressure drop is small and most of it is due to the oxide layer. Impaction efficiencies for the unoxidized screens were correlated with an adjusted Stokes number which employed a hydrodynamic factor. The hydrodynamic factor accounted for the Reynolds number dependence and the dependence on the solids fraction. We used boundary layer theory to predict the Reynolds number dependence and Kuwabara's flow cell model to correct for the influence of neighboring wires on the flow field. The adjusted Stokes number was not needed to correlate the results for the oxidized screens. Impaction efficiencies correlated well with the unadjusted Stokes number. The addition of the copper oxide whiskers on the collector surface increased the drag such that the influence of the fluid inertia was not important for the conditions investigated. The added whiskers created a zone of capture which enhanced filtration efficiencies orders of magnitude.

26270 Ceramic-glass-metal seal by microwave heating. Meek, T.T.; Blake, R.D. (to Dept. of Energy). US Patent Application 6-538,889. 4 Oct 1983. 10p. Contract W-7405-ENG-36.

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A method for producing a ceramic-glass-metal seal by microwaving, mixes a slurry of glass sealing material and coupling agent and applies same to ceramic and metal workpieces. The slurry and workpieces are then insulated and microwaved at a power, time and frequency sufficient to cause a liquid-phase reaction in the slurry. The reaction of the glass sealing material forms a chemically different seal than that which would be formed by conventional heating because it is formed by diffusion rather than by wetting of the reactants.

26271 Ceramic-glass-ceramic seal by microwave heating. Meek, T.T.; Blake, R.D. (to Dept. of Energy). US Patent Application 6-538,890. 4 Oct 1983. 8p. Contract W-7405-ENG-36.

A method for producing a ceramic-glass-ceramic seal by microwaving, mixes a slurry of glass sealing material and coupling agent and applies same to ceramic workpieces. The slurry and workpieces are placed together, insulated and then microwaved at a power, time and frequency sufficient to cause a liquid phase reaction in the slurry. The reaction of the glass sealing material forms a chemically different seal than that which would be formed by conventional heating because it is formed by a diffusion rather than by wetting of the reactants.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 25181, 25588, 25794, 25876, 25882, 25882, 25917, 25922, 25923, 25943, 25974, 25975, 25977, 25978, 26227, 26230, 26407, 26411, 26547, 26579, 26580, 26581, 26582, 26582, 26583, 26584, 26698, 26702, 26908, 27441, 27525, 27547, 27558, 27609

26272 (AD-A—137388/5) Crack paths and hydrogen-assisted crack growth response in aisi 4340 steel. Technical report. Gao, M.; Lu, M.; Wei, R.P. (Lehigh Univ., Bethlehem, PA (USA). Inst. of Fracture and Solid Mechanics). Sep 1983. 48p. (IFSM—83-121; TR—15). NTIS, PC A03/MF A01.

A study of the correlation and crack growth response was undertaken to better define the elemental processes involved in gaseous hydrogen embrittlement. AISI 4340 steel fracture under sustained load in hydrogen and in hydrogen sulfide over a range of temperatures and pressures, whose crack growth kinetics have been well characterized previously, was chosen for study. Fractographic results showed that crack growth followed predominantly along prior-austenite grain boundaries, with a small amount of quasi-cleavage, at low temperatures. At high temperatures, crack growth occurred primarily by microvoid coalescence. The fracture surface morphology, which is indicative of the micromechanisms for crack growth, was essentially the same for hydrogen and hydrogen sulfide. Changes in fracture morphology, i.e., crack paths, corresponded to changes in crack growth kinetics, both of which depended on pressure and temperature. There was no evidence for crack nucleation in advance of the main crack, and this suggests that the fracture process zone is located within one prior-austenite grain diameter from the crack tip.

26273 (ANL—83-24) Optical properties and complex dielectric function of metallic aluminum from 0.04 to 10^4 eV. Smith, D.Y.; Shiles, E.; Inokuti, M. (Argonne National Lab., IL (USA)). Mar 1983. Contract W-31-109-ENG-38. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011428.

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Measurements of the optical properties of metallic aluminum are reviewed and available data are analyzed to obtain the bulk values of the optical constants and the complex dielectric function from 0.04 eV to 10 keV. The intra- and interband contributions to the dielectric function are discussed briefly, and recently proposed values for the Drude parameters describing the intraband absorption are critically considered. Factors influencing experimental measurements are discussed with emphasis on sample properties such as surface oxide layers, bulk inclusion of gases, surface roughness, and degree of crystallinity. The results of recent optical measurements are tabulated, along with recommended values of the optical properties resulting from a self-consistent Kramers-Kronig analysis of reflectance, transmission, and electron-energy-loss studies. The tabular data include the complex dielectric function, the complex index of refraction, and the reflectance and phase shift for normal incidence on a smooth, oxide-free surface. Detailed tabulations are given for the infrared, visible, and ultraviolet regions of the spectrum. 125 references, 8 figures, 4 tables.

26274 (BNL—34342) Potential-determining reactions during pitting corrosion of aluminum. Isaacs, H.S.; Ishikawa, Y. (Brookhaven National Lab., Upton, NY (USA); Hitachi Ltd., Tsuchiura (Japan). Mechanical Engineering Research Lab.). 1984. Contract AC02-76CH00016. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007695.

Scanning measurements of the potential field over surfaces of aluminum, pitting in dilute chlorine solution, has shown that anodic currents are observed over pits and the cathodic reactions within the pits do not contribute significantly to the dissolution rates. The role of nitrate ions, added during pitting, led to increased potentials by reducing the dissolution rates within the pits, rather than increasing cathodic rates within or external to the pit. Potential decreases after a long period of exposure resulted from increased anodic rates rather than inhibited cathodic sites.

26275 (BNL—34595) Intergranular failures of Alloy 600 in high temperature caustic environments. Bandy, R.; Roberge, R.; van Rooyen, D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 17p. (CONF-840405—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010890.

From NACE corrosion '84 international forum and exhibition; New Orleans, LA, USA (1 Apr 1984).

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This paper describes the results of our investigation of two commonly observed modes of failure of Alloy 600 in high temperature caustic environment namely, intergranular stress corrosion cracking (IGSCC) and intergranular attack (IGA). Specimens are studied as C-rings under constant deflection, wires with and without any externally applied load, and as straining electrodes. The potential dependence of average crack propagation rate is established in a single test by using several C-rings held at different potentials, by using a modification of the static potential gradient method of Seys and Van Haute. SCC appears to be governed by a film rupture mechanism and its propagation rate is significantly influenced by the electrochemical potential and associated surface film formation. The maximum crack propagation rate for C-rings and constant

load specimens is very similar but much smaller than that calculated for a straining electrode at the same potential. IGA occurs over a wide range of potential - starting from a few tens of millivolts cathodic to the corrosion potential up to the lower end of anodic potentials normally required for SCC. IGA seems to be rather independent of stress and is generally more pronounced in the crevice area under the nuts used in C-rings. Examination of several creviced coupons shows that outside the crevice, enrichment of iron and chromium occurs on the surface as the potential is raised anodically, whereas the Ni:Fe and Ni:Cr ratios remain relatively independent of potential within the crevice.

26276 **(BNL-NUREG—34270) Mechanisms of intergranular failures in Alloy 600 in high temperature environments.** Bandy, R.; van Rooyen, D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 9p. (CONF-840664—6). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010514.

From 9. international congress on metallic corrosion; Toronto, Canada (3 Jun 1984).

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This paper describes the possible mechanisms underlying intergranular failures of Alloy 600 in three high temperature environments: intergranular stress corrosion cracking (SCC) in caustic (300 to 315°C) and in high purity water (315 to 365°C), and intergranular attack (IGA) in caustic (300 to 315°C). SCC in caustic appears to be governed by a film rupture mechanisms and its propagation rate is influenced by electrochemical potential and associated surface film formation. IGA occurs over a relatively wide range of potential, from a few tens of millivolts cathodic to the corrosion potential up to the lower end of anodic potentials normally required for SCC. SCC in high temperature water is strongly temperature dependent, is accelerated by hydrogen and appears to occur at potentials both anodic and cathodic to the corrosion potential. The possible role of the oxide film rupture in SCC in high temperature water is discussed.

26277 **(CALT—822-138) Cooling rate dependent structure of amorphous (Au/sub x/Cu/sub 1-x/)$_{91}$La$_9$.** Atzmon, M.; Johnson, W.L. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Nov 1982. Contract AT03-81ER10870. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010828.

A novel class of metallic glasses of the form (Au/sub x/Cu/sub 1-x/)$_{91}$La$_9$ (x = 0.5, 0.25, 0.6) and (Au/sub 0.5/Cu/sub 0.5)/sub 1-y/ (y = 10, 11) has been prepared by rapid cooling from the melt. Investigation by means of x-ray diffraction and TEM shows a dependence of the structure on the cooling rate and suggests a phase separated amorphous structure. For sufficiently low cooling rates, crystallization seems to follow phase separation.

26278 **(CONF-840417—Absts.) High-temperature alloys: theory and design.** (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010428.

From High-temperature alloys - theory and design conference; Bethesda, MD, USA (8 Apr 1984).

Abstracts are presented of 35 papers, grouped under the following session headings: thermodynamics and phase diagrams, recent results in alloy design, analysis techniques, electronic structure of disordered alloys, and electronic structure and ordering in alloys. (DLC)

26279 **(CONF-840664—1) Oxidation-sulfidation behavior of Fe-Cr-Ni alloys containing additions of Zr, Nb, OR Ti.** Baxter, D.J.; Natesan, K. (Argonne National Lab., IL (USA)). Dec 1983. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005411.

From 9. international congress on metallic corrosion; Toronto, Canada (3 Jun 1984).

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Rapid degradation of Fe-Cr-Ni alloys may occur in mixed oxygen- and sulfur-containing environments at elevated temperatures unless a protective surface oxide scale can be formed and maintained. The present results indicate that alloy chemistry has a strong influence on the scaling behavior of a Fe-25% Cr-20% Ni-base alloy. The presence of Mn (which forms a stable sulfide at low sulfur potentials) or Ti (which permits high rates of oxide growth) may contribute to breakaway behavior, whereas the addition of either of two reactive elements, Zr or Nb, promotes protection by an oxide scale. Mechanisms to explain the effects of individual elemental additions to the base alloy are discussed. 8 figures.

26280 **(CONF-8404103—2) Sulfur and antimony segregation to creep cavity surfaces in Ni and an FCC Fe-Ni-Cr alloy.** White, C.L.; Schneibel, J.H.; Yoo, M.H. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011458.

From 2. international conference on creep and fracture of engineering materials and structures; Swansea, UK (1 Apr 1984).

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Segregation of S and Sb to the internal free surfaces of creep induced cavities and microcracks in Ni and an Fe + 15% Ni + 15% Cr alloy have been studied using scanning Auger electron spectroscopy (AES). Residual S is found to segregate strongly in the undoped Fe + 15% Ni + 15% Cr while Fe + 15% Ni + 15% Cr + 1% Sb exhibited only Sb segregation. Both S and Sb segregated in Ni + 0.15% Sb.

26281 (DL/SCI/R—19, pp 20-27) **Diffraction studies of grain boundary structure using synchrotron radiation.** Budai, J.; Milkove, K.R.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The present paper describes how the diffraction approach can be used to determine a grain boundary structure and the advantages of synchrotron radiation for such studies; presents the first determination of a projected boundary structure made using only diffraction information; compares boundary structures in different metals; discusses grain boundary structural width measurements; and then makes generalizations concerning the structure of large angle [001] twist boundaries based on diffraction observations.

26282 (DL/SCI/R—19, pp 54-55) **X-ray topography of terfernol.** Lord, D.G. (Salford Univ. (UK). Dept. of Pure and Applied Physics). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

This paper reports some preliminary results of X-ray topography investigations of terfernol (Tbsub(0.27)Dysub(0.73)Fe$_2$) crystals exhibiting high densities of inclusions and precipitates.

26283 (DL/SCI/R—19, pp 56-65) **Significance of X-ray imaging techniques in the study of ferro-or ferri-magnets.** Miltat, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Solides; Laboratoire pour l'Utilisation du Rayonnement Electromagnetique (LURE), Paris-11 Univ., 91 - Orsay (France)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The subject is discussed under the headings: introduction; basic physics of Bloch wall statics (magnetization (a) parallel (b) perpendicular, to the surface); magnetostrictive strains; detectability of magnetostrictive strains by means of X-ray imaging techniques; interactions of individual lattice defects and moving walls (optical studies; X-ray studies); conclusion.

26284 (DL/SCI/R—19, pp 96-100) **White beam synchrotron fractography of molybdenum and niobium single crystals.** Bilello, J.C.; Hmelo, A.B. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering); Davies, S.T. (Warwick Univ., Coventry (UK). Dept. of Engineering); Bowen, D.K. (Warwick Univ., Coventry (UK)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

It has been demonstrated that a White Beam Synchrotron reflection technique can be used to characterize the fracture surface of Mo and Nb single crystals. This technique when used in conjunction with Berg-Barrett (or in the future monochromatic synchrotron topography) gives detailed information which correlates the internal defect structure to the cleavage surface morphology. In particular, synchrotron fractography has revealed the full extent of the plastic zone associated with a precursor crack, has clearly identified the nature of the initial crack where more than one precursor could have existed, and give detailed information on the extent of twinning and microtwinning. In comparison with other fractography methods for such semi-brittle metals the White Beam Synchrotron method not only achieves rapid data collection, but also provides internal defect structure correlation non-destructively.

26285 (DOE/DP/00563—1) **Materials compatibility with the volcanic environment. Final report.** Htun, K.M. (Hawaii Univ., Honolulu (USA). Dept. of Mechanical Engineering). 8 Mar 1984. Contract AS08-76DP00563. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010524.

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Attempts were made to run materials compatibility, volcanic gas collection, and heat transfer experiments during the 1977 Kilauea eruption. Preliminary results from the recovered samples showed that Fe, Ni, and Fe-Ni alloys were the most heavily oxidized. The Mo and W alloys showed some attack and only neglible reaction was seen on 310 stainless, Hastelloy C, Inconel 600, Inconel 718, Rene 41, and Nichrome. Results are qualitative only. (DLC)

26286 (DOE/ER—0045/11, pp 38-41) **Neutronics calculations in support of the ORR-MFE-4A and -4B spectral tailoring experiments.** Lillie, R.A. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The calculated fluences from the ongoing three-dimensional neutronics calculations are being scaled to agree with experimental data. As of September 30, 1983, this treatment yields 121.6 at. ppM He (not including 2.0 at. ppM He from ^{10}B) and 8.25 dpa for type 316 stainless steel in ORR-MFE-4A and 69.3 at. ppM He and 5.19 dpa in ORR-MFE-4B.

26287 (DOE/ER—0045/11, pp 53-59) **Improved swelling resistance for PCA austenitic stainless steel under HFIR irradiation through microstructural control.** Maziasz, P.J.; Braski, D.N. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Swelling evaluation of PCA variants and 20%-cold-worked (N-Lot) type 316 stainless steel (CW 316) at 300 to 600°C was extended to 44 dpa. Swelling was negligible in all the steels at 300°C after ~ 44 dpa. At 500 to 600°C 25%-cold-worked PCA showed better void swelling resistance than type 316 at ~ 44 dpa. There was less swelling variation among alloys at 400°C, but again 25%-cold-worked PCA was the best.

26288 (DOE/ER—0045/11, pp 60-65) **Microstructural design of PCA austenitic stainless steel for improved resistance to helium embrittlement under HFIR irradiation.** Maziasz, P.J.; Braski, D.N. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Microstructural variants of PCA and two heats of 20%-cold-worked type 316 stainless steel were irradiated in HFIR and tested for embrittlement resistance with the disk-bend test. No embrittlement was observed for irradiation to ~ 44 dpa and 3000 to 3600 at. ppM He at 300 and 400°C. All materials were brittle after similar irradiation at 600°C. The test embrittlement resistance for irradiation to 44 dpa at 500°C and to 22 dpa at 600°C was found in PCA variants that contained grain boundary MC particles produced prior to irradiation.

26289 (DOE/ER—0045/11, pp 67-71) **Evaluation of fatigue properties of HFIR-irradiated nimonic PE-16 at 430°C.** Grossbeck, M.L.; Liu, K.C. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Nimonic PE-16 was irradiated in the HFIR to 6 to 9 dpa and 560 to 1000 at. ppM He at 430°C. Postirradiation fatigue tests revealed a reduction in fatigue life by about a factor of 10 at 430°C. In contrast with AISI type 316 stainless steel, no endurance limit was observed. All irradiated specimens exhibited some intergranular fracture with an increasing tendency toward cleavage like intragranular fracture for low strain ranges.

26290 (DOE/ER—0045/11, pp 75-81) **Swelling in several commercial alloys irradiated to very high neutron fluence.** Gelles, D.S.; Pintler, J.S. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Swelling values have been obtained from a set of commercial alloys irradiated in EBR-II to a peak fluence of 2.5 x 10^{23} n/cm^2 (E > 0.1 MeV) or ~ 125 dpa covering the range 400 to 650°C. The alloys can be ranked for swelling resistance from highest to lowest as follows: the martensitic and ferritic alloys, the niobium based alloys, the precipitation strengthened iron and nickel based alloys, the molybdenum alloys and the austenitic alloys.

26291 (DOE/ER—0045/11, pp 82-94) **Evaluation of ferritic alloy Fe-2-1/4Cr-1Mo after neutron irradiation: irradiation creep and swelling.** Gelles, D.S.; Puigh, R.J. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Irradiation creep and swelling measurements are reported for Fe-2-1/4Cr-1Mo after irradiation by fast neutrons over the temperature range 390 to 560°C. Diameter change measurements on thin walled pressurized tubes in a bainitic condition and density change measurements on rods in a nonstandard condition were made following irradiation in the Experimental Breeder Reactor II. The irradiation creep specimens were irradiated to a fluence of 5.7 x 10^{22} n/cm^2 (E > 0.1 MeV) or 30 dpa and the swelling specimens were irradiated to a peak fluence of 2.4 x 10^{23} n/cm^2 or 115 dpa. These results have been used as a basis to establish in-reactor creep and swelling correlations for 2-1/4Cr-1Mo in a bainitic condition. The correlations predict moderate swelling and moderate irradiation enhanced creep at 390°C.

26292 (DOE/ER—0045/11, pp 95-102) **Elevated-temperature tensile properties of 2 1/4 Cr-1 Mo steel irradiated in the EBR-II, AD-2 experiment.** Klueh, R.L.; Vitek, J.M. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The effect of irradiated on the tensile properties of 2 1/4 Cr-1 Mo steel was determined for specimens irradiation in EBR-II at 390 to 550°C. Unirradiated control specimens and specimens aged for 5000 h at the irradiation temperatures were also tested. Irradiation to approximately 9 dpa at 390°C increased the strength and decreased the ductility compared with the unirradiated and aged specimens. Softening occurred in samples irradiated and tested at 450, 500, and 550°C.

26293 (DOE/ER—0045/11, pp 103-107) **Swelling in simple ferritic alloys irradiated to high fluence.** Gelles, D.S.; Meinecke, R.L. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

A series of Fe-Cr-C-Mo simple alloys has been measured for density change as a function of irradiation in EBR-II over the temperature range 400 to 650°C to fluences as high as 2.13 x 10^{23} n/cm^2 (E > 0.1 MeV) or 105 dpa. The highest swelling was found in a Fe-12Cr binary alloy, 4.72 percent, after 1.87 x 10^{23} n/cm^2 or 95 dpa at 425°C, which corresponds to a swelling rate of 0.06%/dpa. This peak swelling rate value can be used to define swelling predictions for commercial ferritic alloys to 40 MWy/m^2.

26294 (DOE/ER—0045/11, pp 108-114) **Microstructure of 9 Cr-1 MoVNb and 12 Cr-1 MoVW ferritic steels after irradiation at elevated temperatures in HFIR.** Vitek, J.M.; Klueh, R.L. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Microstructures of 9 Cr-1 MoVNb and 12 Cr-1 MoVW were examined following irradiation in HFIR to 36 dpa at 300 to 600°C. Maximum cavity development in the form of voids occurred at 400°C with only small helium bubble formation at 500 and 600°C. Swelling was greater in 9 Cr-1 MoVNb than in 12 Cr-1 MoVW. The cavity development is attributed in part to the production of helium during irradiation.

26295 (DOE/ER—0045/11, pp 115-127) **Effects of HFIR irradiation at 55°C on the microstructure and toughness of HT-9 and 9Cr-1Mo.** Gelles, D.S.; Hu, W.L.; Huang, F.H.; Johnson, G.D. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Results are reported for base metal and weld metal specimens of HT-9 and Modified 9Cr-1Mo following irradiation in HFIR at 55°C to 5 dpa. The DBTT shifts in irradiated base metal specimens were 30°C for HT-9 and 90°C for 9Cr-1Mo with further shifts of 20°C for weld metal. Concurrently, strength as measured by hardness increased 15 percent for HT-9 and 25 percent for 9Cr-1Mo. The hardness increases can be attributed in part to defect clusters 1.5 to 3.0 nm in diameter at densities approaching 10^{17} cm^{-3} and also to lower rates of cavity nucleation ahead of the propagating crack.

26296 (DOE/ER—0045/11, pp 128-135) **Fractographic examination of HT-9 miniature compact tension specimens tested at low temperatures.** Gelles, D.S.; Huang, F.H. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Fractographic examinations have been performed on a series of miniature compact tension specimens of HT-9 tested at room temperature and below. Reductions in toughness found for these specimens are shown to be associated with transgranular cleavage fracture and are a function of the plastic deformation which occurs prior to the onset of brittle fracture.

26297 (DOE/ER—0045/11, pp 136-142) **Postirradiation notch ductility tests of ESR alloy HT-9 and modified 9Cr-1Mo alloy from UBR reactor experiments.** Hawthorne, J.R. (Naval Research Lab., Washington, DC). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

During this period, irradiation exposures at 300°C and 150°C to ~ 8 x 10^{19} n/cm^2, E > 0.1 MeV, were completed for the Alloy HT-9 plate and the modified Alloy 9Cr-1Mo plates, respectively. Postirradiation tests of Charpy-V (C/sub v/) specimens were completed for both alloys; other specimen types included in the reactor assemblies were fatigue precracked Charpy-V (PCC/sub v/), half-size Charpy-V, and in the case of the modified 9Cr-1Mo, 2.54 mm thick compact tension specimens.

26298 (DOE/ER—0045/11, pp 143-147) **Effect of specimen size and nickel content on the impact properties of 12 Cr-1 MoVW ferritic steel.** Corwin, W.R.; Klueh, R.L.; Vitek, J.M. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Charpy impact properties were developed on six heats of 12 Cr-1 MoVW steel with full- and subsize specimens to examine effects of nickel and chromium adjustments. These data provide a baseline for comparison of effects of irradiation on the impact properties of these alloys.

26299 (DOE/ER—0045/11, pp 148-151) **Grain boundary segregation and embrittlement in a 12Cr-1Mo steel resulting from cooling rate variations.** Hyzak, J.M.; Garrison, W.M. (Sandia National Labs., Livermore, CA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Segregation of embrittling elements, especially phosphorous, to the prior austenite grain boundaries in this 12Cr-1Mo steel has been shown to reduce tensile ductility, increase grain boundary fracture, and affect hydrogen compatibility. Tests were performed to determine the influence of variations in cooling rate during heat treatment on the tensile properties. The non-hydrogen exposed tensile ductility increased and the occurrence of intergranular rupture decreased as the cooling rates were increased. Phosphorous segregation at the prior austenite grain boundaries also decreased as the cooling rates were increased.

26300 (DOE/ER—0045/11, pp 152-154) **Assessment of the weldability of HT-9 using a Y-groove test.** Hilderbrand, J.F.; Foulds, J.R.; Lechtenberg, T.A. (GA Technologies, Inc., San Diego, CA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

A minimum preheat temperature of 200°C (392°F) was found necessary for gas tungsten-arc (GTA) welding HT-9 plate of thickness 9.5 mm (3/8 in.) and 16 mm (5/8 in.). Thermal shock treatments produced no cracking in welded test specimens.

26301 (DOE/ER—0045/11, pp 155-161) **Time-temperature characteristics of the various heat-affected zones in HT-9 weldments.** Foulds, J.R. (GA Technologies, Inc., San Diego, CA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Temperatures at different distances from the fusion boundary were measured during GTA weld depositing MTS-4 filler wire on 9.52-mm (3/8 in.) thick HT-9 plate. Peak temperature measurements indicate each of the heat-affected regions to be austenitized. An exponential expression has been used to describe the cooling curves as a function of peak temperature (or distance) from the fusion boundary.

26302 (DOE/ER—0045/11, pp 163-170) **TEM observations of HT-9 as-welded weldment microstructures.** Foulds, J.R.; Lechtenberg, T.A. (GA Technologies, Inc., San Diego, CA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

TEM studies of different locations in an HT-9 weldment indicated delta-ferrite (δ) occurrence, $M_{23}C_6$ precipitation at δ-martensite interfaces, fine carbide precipitation at prior austenite grain boundaries, and martensite lath and lath packet size to be the distinguishable microstructure features observed. Furthermore, retained austenite films were observed in the weld metal and the HAZ adjacent to the weld metal that reached the highest temperature during joining. The microstructures correlate well with the observed room temperature microhardness except for the fusion boundary in weld metal which exhibited a hardness drop and an unexpected minimum amount of delta-ferrite.

26303 (DOE/ER—0045/11, pp 172-179) **J/sub 1c/ fracture toughness transition behavior of HT-9.** Huang, F.H. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Small compact tension specimens of two heats of HT-9 were tested at temperatures ranging from room temperature to -192°C. The ductile-brittle transition toughness of HT-9 was evaluated using the J-integral approach. There were two loading rates of 2.1 x 10^{-5} m/s and 3.2 x 10^{-2} m/s. The ductile-brittle transition temperatures of HT-9 (number 1 heat) tested at 2.1 x 10^{-5} m/s and HT-9 (number 2 heat) tested at 3.2 x 10^{-2} m/s were found to be -60 and -10°C, respectively. Results showed the fracture toughness of the former was not sensitive to loading rate and the lower shelf toughness decreased with temperature to a J/sub 1c/ value of 5 kJ/m^2 at -190°C. Furthermore, the values of J/sub 1c/ were valid since the thickness of the test specimens was well above the thickness criterion.

26304 (DOE/ER—0045/11, pp 180-184) **Fracture toughness of ferritic alloys irradiated in HFIR.** Huang, F.H. (Westinghouse Hanford Co., Richland, WA). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The fracture toughness of HT-9 and 9Cr-1Mo irradiated in HFIR to 10 dpa at 50°C was evaluated using electropotential single specimen techniques. Circular compact tension specimens were tested at temperatures ranging from room temperature to 450°C. The test results were analyzed using the J-integral approach. Analyses showed that the fracture toughness of both alloys was reduced as a result of HFIR irradiation. The degradation of irradiation toughness resistance was more severe for 9Cr-1Mo than HT-9. The thickness criterion for valid J/sub 1c/ values was satisfied by the thickness of the test specimens.

26305 (DOE/ER—0045/11, pp 197-202) **Corrosion of path A PCA and 12 Cr-1 MoVW steel in thermally convective lithium.** Tortorelli, P.F.; DeVan, J.H. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Exposure of path A PCA alloys to thermally convective lithium for 6700 h at 600 and 570°C resulted in corrosion reactions that were similar to what is observed for other austenitic alloys exposed under similar conditions. It corroded more rapidly than type 316 stainless steel, and the presence of nitride stringers in PCA did not affect the measured weight losses. Consideration of the weight change and surface analysis data for 12 Cr-1 MoVW steel exposed to thermally convective lithium between 500 and 350°C for 10,088 h revealed that reactions with carbon and nitrogen were probably the principal corrosion processes for this alloy in this temperature range. Corrosion was not severe.

26306 (DOE/ER—0045/11, pp 203-204) **Corrosion of type 316 stainless steel in flowing Pb-17 at. % Li.** Tortorelli, P.F.; DeVan, J.H. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The corrosion of type 316 stainless steel exposed to thermally convective Pb-17 at. % Li was severe. Plugging started to occur after just several hundred hours. At 500°C, the weight loss of type 316 stainless steel exposed to Pb-17 at. % Li was more than an order of magnitude greater than that of this alloy exposed to thermally convective lithium at 600°C.

26307 (DOE/ER—0045/11, pp 205-208) **Compatibility studies of structural alloys with solid breeder materials.** Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Compatibility tests between Li_2O pellets and austenitic type 316 stainless steel or ferritic HT-9 alloy and Fe-9Cr-1Mo steel in a flowing-helium environment indicate that the reaction rates in helium containing 93 ppM H_2O are greater than in helium with 1 ppM H_2O. The corrosion behavior of type 316 stainless steel is similar to that of the ferritic steels. The Li_2O pellets, exposed both with and without the alloy specimens, lose weight in flowing helium.

26308 (DOE/ER—0045/11, pp 209-215) **Corrosion and oxidation of vanadium-base alloys in helium environments.** Loomis, B.A.; Smith, D.L. (Argonne National Lab., IL). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The increase in weight of unalloyed V and V-5Ti, V-15Cr and V-15Cr-5Ti alloys at 725, 825 and 925 K was determined for exposure times ranging up to 1000 hours in He containing H_2 and/or H_2O impurity. The microhardness of the specimens in a transverse section was also determined after exposure for 1000 hours. These results were utilized to discuss the consequences of the selection of certain radiation-damage resistant, V-base alloys for structural materials applications in a fusion reactor.

26309 (DOE/ER—0045/11, pp 216-220) **Environmental effects on properties of structural alloys.** Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Corrosion data are presented for several austenitic and ferritic steels exposed at temperatures between 700 and 755 K in flowing lithium and Pb-17Li environments. The results indicate that dissolution rates for both steels are an order of magnitude greater in Pb-Li than in lithium. Tensile data for cold-worked type 316 stainless steel show that a flowing environment has no effect on the tensile properties of type 316 stainless steel at temperatures between 473 and 773 K.

26310 **(DOE/ER/01198—1407) Formation of dispersions of rare earth oxides in titanium alloys using rapid solidification processing.** Konitzer, D.G. (Illinois Univ., Urbana (USA)). 1984. Contract AC02-76ER01198. 200p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84008664.

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Rapid solidification processing (RSP) was used to produce extended solid solutions of rare earth elements and O in Ti and some of its alloys. RSP was affected by laser surface melting and the resulting microstructures characterized using analytical TEM. Heat treatment, typically 10 h at 1000°K, results in the formation of an ultrafine dispersion of rare earth oxides. In the case of Er_2O_3, the particles are 8 to 20 nm in diameter with a mean interparticle spacing of 120 nm. The point and space groups of these precipitates are consistent with these being m3 and Ia3, respectively, which are identical with those of the rare earth oxides Y_2O_3, Er_2O_3. The orientation relationships (OR) exhibited by these oxide particles were studied. The coarsening equations, modified for Er_2O_3 particles in a Ti matrix, have been used to predict the coarsening behavior of the dispersions produced in this work. If the composition of the alloy contains an excess amount of Er, the particles exhibit remarkable stability up to the β-transus. Above this temperature, the coarsening rate increases markedly. For a slight excess of O, the stability of the particles is extremely improved up to above 1200°K. In a specimen tested to failure, there was a marked increase in mechanical strength.

26311 **(DOE/ER/52089—3) Influence of a temperature change on in-reactor creep.** Chin, B.A.; Gilbert, E.R. (Auburn Univ., AL (USA). Dept. of Mechanical Engineering; Pacific Northwest Lab., Richland, WA (USA)). 18 Jun 1984. Contract AS05-82ER52089. 30p. (CONF-840604—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010784.

From 12. international symposium on effects of radiation on materials; Williamsburg, VA, USA (18 Jun 1984).

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The results of a series of pressurized tube creep experiments were evaluated to determine the effect of a temperature change on the in-reactor creep of AISI 316 stainless steel. In contrast to prior

experiments where a temperature change was imposed and only a short interval of additional fluence accumulated prior to examination, this experiment examines the long term effects of a temperature change. Data are reported from three separate experiments in which the temperature history was altered by a linear reduction with fluence, a step increase and a step decrease. Analysis of the data indicated that the long term creep rate adjusts to the new temperature. However, evidence of swelling and stress affected swelling resulting from the temperature change were found.

26312 **(DOE/OR/03054—90) Determination of corrosion rates for steel alloys in process solvent. Final technical report.** Latos, E.J. (Signal UOP, Inc., Des Plaines, IL (USA). Research Center). Jan 1984. Contract AC05-78OR03054. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010809.

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The objectives of this program were to determine the corrosion rate, under static and dynamic conditions, of AISI 1010, 5 Cr-0.5 Mo, Type 304L and Type 316L steels in an SRC-I, V-178, coal-derived liquid at temperatures ranging from 550°F (288°C) to 700°F (371°C) and to analyze the after-test liquids for metal content, and physical and chemical properties to determine stability under these test conditions. In addition, the program included a study to determine the storage stability of the V-178 coal-derived liquid at 110°F (43.3°C) in air. 6 references, 32 figures, 35 tables.

26313 **(DP-MS—84-13) Deformation and strain analysis for high extrusion ratios and elevated temperatures.** Berghaus, D.G.; Peacock, H.B. (Georgia Inst. of Tech., Atlanta (USA). School of Engineering Science and Mechanics; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 8p. (CONF-8406101—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010152.

From 5. international congress on experimental mechanics; Montreal, Quebec, Canada (10 Jun 1984).

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Axisymmetric extrusion of aluminum at 450°C is being studied using the visioplastic method. A full field strain distribution is obtained through a conical die which has an extrusion ratio of 13 to 1. Strains are determined from changes in the shape of flow lines that were originally ink stamped on an axial plane of the billet. Numerical methods are described for approximation, differentiation, and integration of the material flow functions and strain rates. Good agreement is found between calculated and measured flow patterns.

26314 **(EUR—7998) Comments upon the International Conference on point defects and defect interactions in metals.** Schuele, Wolfgang. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1982. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700920.

89 refs.

Many experimental results are discussed, which were not correctly evaluated and interpreted in the past and which show that the "one interstitial model" is not valid. A new radiation damage model, the "modified two interstitial model" is introduced and many experimental results obtained in the field of radiation damage during the last twenty years are re-discussed. Some important features which result from the new model regarding for instance void formation or the value of simulation experiments are presented.

26315 **(EUR—8502) Joint exercise to compare fatigue crack growth data obtained on type 304/316 stainless steel. Final report.** Krompholz, K.; Lloyd, G.J.; Petrequin, P. (Commission of the European Communities, Luxembourg). 1983. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700911.

The Activity Group 3 "Materials" of the Working Group on Codes and Standars of the Fast Reactor Co-ordinating Committee (FRCC) has set itself the task of comparing fatigue crack growth data obtained on type 304/316 ss, which are used as structural materials in fast reactor applications in the European Community. The available data which reflect the influence of parameters (frequency, stress ratio, environmental impact etc.) are collected in tables and the respective plots are also presented.

26316 **(HEDL—7432) Transmutation of manganese - substituted steels in STARFIRE.** Heinisch, H.L.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1984. Contract AC06-76FF02170. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010402.

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The transmutations calculated for the STARFIRE wall employing the manganese substitution alloys currently under investigation in the DAFS program are not expected to greatly change the phase stability of these alloys.

26317 **(HEDL-SA—3005-FP) Ring ductility of irradiated Inconel 706 and Nimonic PE16.** Huang, F.H.; Fish, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 13 Feb 1984. Contract AC06-76FF02170. 22p. (CONF-840604—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010397.

From 12. international symposium on effects of radiation on materials; Williamsburg, VA, USA (18 Jun 1984).

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The tensile ductility of fast neutron-irradiated, precipitation-hardened alloys Inconel 706 and Nimonic PE16 has been observed to be very low for certain test conditions. Explanations for the low ductility behavior have been sought by examination of broken tensile specimens with microscopy and other similar techniques. A ring compression test provides a method of evaluating the ductility of irradiated cladding specimens. Unlike the conventional uniaxial tensile testing in which the tensile specimen is deformed uniformly, the ring specimen is subjected to localized bending where the crack is initiated. The ductility can be estimated through an analysis of the bending of a ring in terms of strain hardening. Ring sections from irradiated, solution-treated Inconel 706 and Nimonic PE16 were compressed in the diametral direction to provide load-deflection records over a wide range of irradiation and test temperatures. Results showed that ductility in both alloys decreased with increasing test temperatures. The poorest ductility was exhibited at different irradiation temperatures in the two alloys - near 550°C for PE16 and 460 to 520°C for Inconel 706. The ring ductility data indicate that the grain boundary strength is a major factor in controlling the ductility of the PE16 alloy.

26318 **(HW—54341) Some aspects of the corrosion of buried stainless steel pipe at the Hanford Works.** Plott, R.F. (Hanford Works, Richland, WA (USA)). 1948. Contract AC06-76RL01857. 49p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010815.

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An exploratory study of the severe corrosion of Type 347 stainless steel buried in the semi-arid region of Eastern Washington has been made. The possible influence of bacteriological presence upon this corrosion was investigated. Corrosion foci of both the anodic and cathodic regions along the stainless steel specimens appear to be intimately associated with the fact that the stainless steel is imbedded in weathered or weathering rock. The weathering processes occurring in the rock are known to be primarily of a chemo-bacteriological nature after the initial physical processes have subsided. The tentative hypothesis of the mechanism of this stainless steel corrosion is proposed to be electrochemical. This electrochemical corrosion possibly is complemented by the sulfate reduction-sulfide oxidation cycle caused by the presence of a community of bacterial types living in a mutual symbiosis. These observed bacterial types are believed to preserve the continuity of the electrochemical process by the depolarization of the cathodes along the stainless steel and by the maintenance of a suitable acidity of the soil in which the stainless steel is buried. The corrosion of Type 347 stainless steel appears to be intergranular in character and the causative agent, sulfuric acid, is being formed by bacterial action.

26319 (IC—82/159) Thermodynamic properties of liquid metals. Kumaravadivel, R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1982. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700917.

The ability of the model potentials to yield accurate thermodynamic properties of liquid metals is tested. The pressure and bulk moduli calculated by the homogeneous deformation (HD) method depend on the electron density derivative of the self energy. The latter is determined predominantly by the choice and specification of the bare ion form factor for q>2ksub(F). Most of the empirical model potentials in the literature have been tested to give good description only in the region 0<=q<=2ksub(F). The bare ion form factor widely differ from one another for q>2ksub(F) and are not tested to give good description in this range. Therefore no meaningful calculation of the pressure and bulk moduli of liquid metals could be made at present by the HD method. The long wavelength (LW) method of calculating the bulk moduli involve only the pair potential, which is determined mainly by the choice and specification of the bare ion form factor in the region 0<=q<=2ksub(F). Therefore the LW method can give quantitative results for the compressibility. For Na and K, pair potentials calculated from Shaw's full non-local, energy dependent pseudo-potentials with the inclusion of appropriate effective masses and depletion hole charges is found to give remarkably good results for volume independent properties such as the packing fraction, entropy, constant volume specific heat, the long wavelength of the structure factor and the bulk modulus calculated by the LW method. The Ashcroft model potential is the best of all available local model potentials, but being a local one parameter potential can give only semi quantitative results for cohesive energy and bulk modulus calculated by the LW method.

26320 (IC—82/170) Trial charge density profiles at the metallic surface and work functions calculations. Wojciechowski, K.F. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700912.

We present a brief report outlining the density functional formalism to calculate the work function of a clean metal, as well as one covered by metallic submonolayer, using the trial charge density profiles at the surface of the considered system. It is shown also that if the total charge density profile nsub(T)(x) satisfies at the surface of jellium the Budd-Vannimenus constraint and is a symmetrical one, relative to y-axis, then the work function variations vs. Wigner-Seitz radius do not depend on the form of nsub(T)(x).

26321 (IC—83/2) Electrical resistivity of liquid Ag-Au alloy. Anis Alam, M.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700918.

Calculations of the dependence of the electrical resistivity in liquid Ag-Au binary alloy on composition are reported. The structure of the binary alloy is described as a hard-sphere system. A one-parameter local pseudopotential, which incorporates s-d hybridization effects phenomenologically, is employed in the resistivity calculation. A reasonable agreement with experimental trend is observed.

26322 (IC—83/71) Structural energetics of heavy alkali metals: Pseudopotential theory revisited. Mujibur Rahman, S.M.; Mazibar Rahman, M.; Chowdhury, S.M.M.R. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700913.

We investigate the structural energetics of the heavy alkali metals, namely, K, Rb and Cs by using the third-order perturbation theory. In the calculations we employ the non-local transition metal pseudopotential and also take into account the effects due to the orthogonalization hole. The BCC structure is found to have the lowest energy for all of these metals.

26323 (IC—83/74) Asymptotic elastic energy in simple metals. Khalifeh, J.M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700914.

The asymptotic form of the elastic binding energy ΔEsup(as)(R) between two Mg atoms in Al is expressed as a product of a lattice Green function and the dipole force tensor P. The quantity P is obtained by a nearly free electron model in which the impurity effect is introduced by a screened Ashcroft pseudopotential characterized by an excess charge ΔZ and a core radius rsub(j).

26324 (IC—83/79) Local atomic ordering in nickel based Ir and Rh alloys. Tahir Abbas; Khawaja, F.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700915.

Experimental measurements of the diffuse X-ray scattering are performed on alloys of Ni with Rh and Ir. The atomic short range order (SRO) parameters αsub(i) are calculated from the measured intensity. The existence of SRO is established in the two systems. The values of α_1 are observed to have anomalously large negative values for all the samples. The experimental data so obtained is interpreted theoretically by calculating the interaction energies on the basis of electronic theory of ordering. Theoretically calculated values of interaction energies are found to be in agreement with the experimentally determined type of order in these alloys.

26325 (IC—83/82) Monte Carlo studies of domain growth in two dimensions. Yaldram, K.; Ahsan Khan, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700916.

Monte Carlo simulations have been carried out to study the effect of temperature on the kinetics of domain growth. The concept of "spatial entropy" is introduced. It is shown that "spatial entropy" of the domain can be used to give a measure of the roughening of the domain. Most of the roughening is achieved during the initial time (t<or approx. 10 Monte Carlo cycles), the rate of roughening being greater for higher temperatures. For later times the roughening of the domain for different temperatures proceeds at essentially the same rate.

26326 (INIS-SU—203, pp 74-76) Study of radiation defects in germanium by positron annihilation method. Arifov, P.U.; Arutyunov, N.Yu.; Emtsev, V.V.; Rubinova, Eh.Eh.; Trashchakov, V.Yu. (AN Uzbekskoj SSR, Tashkent. Inst. Ehlektroniki). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

The effect of point radiation defects on annihilation characteristics in neutron-irradiated n-type germanium has been investigated by measuring angular distributions of annihilation photons. The samples were oriented along the crystallographic directions (111), (110) and (100). The parameters of the material were determined from temperature dependences of the Hall coefficient and conductivity. "Positron-sensitive" point radiation defects are found to dominate at first stages of the neutron irradiation. The results are compared with similar data, obtained earlier for the gamma-irradiated material by positron annihilation. It is concluded that the defects considered are electrically inactive complexes with doped atoms of the fifth group donors.

26327 (INIS-SU—203, pp 90-92) Annealing of radiation defects in aluminium irradiated with 32 MeV electron at 4.2 K. Zelenskij, V.F.; Neklyudov, I.M.; Petrusenko, Yu.T.; Reznichenko, Eh.A.; Zykov, A.A. 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

26328 (LA—9965-MS) Development of plutonium transmission electron microscopy. Rohr, D.L.; Staudhammer, K.P.; Johnson, K.A. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011017.

Efforts to develop routinely successful methods to prepare samples for transmission electron microscopy are described. Since this work has been performed intermittently for nearly 20 y, the background, the technical need for the work, and the future plans all are also discussed.

26329 **(LBL—16263) Near-threshold fatigue crack propagation: a perspective on the role of crack closure.** Suresh, S.; Ritchie, R.O. (Brown Univ., Providence, RI (USA). Div. of Engineering; Lawrence Berkeley Lab., CA (USA)). Nov 1983. Contract AC03-76SF00098. 76p. (CONF-8310268—1). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84009669.

From International symposium on concepts of fatigue crack growth threshold; Philadelphia, PA, USA (2 Oct 1983).

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In recent years, mechanistic and continuum studies on fatigue crack propagation, particularly at near-threshold levels, have highlighted a dominant role of crack closure in influencing growth rate behavior. In this paper we review and model the various sources of closure induced by cyclic plasticity, corrosion deposits, irregular fracture morphologies, viscous fluids and metallurgical phase transformations. It is shown that many of the commonly observed effects of mechanical factors, such as load ratio, microstructural factors, such as strength and grain size, and certain environmental conditions can be traced to the extrinsic influence of closure in modifying the effective driving force for crack extension. The implications of such closure mechanisms are discussed in the light of constant and variable amplitude fatigue behavior, the existence of a threshold stress intensity for no fatigue crack growth and the validity of such threshold concepts for the case of short fatigue cracks. 106 references, 21 figures.

26330 **(N—8410268) Low strain, long life creep fatigue of AF2-1DA and INCO 718.** Thakker, A.B.; Cowles, B.A. (Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA)). Apr 1983. 152p. (NASA-CR—167989). NTIS, PC A08/MF A01.

Two aircraft turbine disk alloys, GATORIZED AF2-DA and INCO 718 were evaluated for their low strain long life creep-fatigue behavior. Static (tensile and creep rupture) and cyclic properties of both alloys were characterized. The cntrolled strain LCF tests were conducted at 760 C (1400 F) and 649 C (1200 F) for AF2-1DA and INCO 718, respectively. Hold times were varied for tensile, compressive and tensile/compressive strain dwell (relaxation) tests. Stress (creep) hold behavior of AF2-1DA was also evaluated. Generally, INCO 718 exhibited more pronounced reduction in cyclic life due to hold than AF2-1DA. The percent reduction in life for both alloys for strain dwell tests was greater at low strain ranges (longer life regime). Changing hold time from 0 to 0.5, 2.0 and 15.0 min. resulted in corresponding reductions in life. The continuous cycle and cyclic/dwell initiation failure mechanism was predominantly transgranular for AF2-1DA and intergranular for INCO 718.

26331 **(NUREG/CR—3295-Vol.1) Light water reactor pressure vessel surveillance dosimetry improvement program. Volume 1. Notch ductility and fracture toughness degradation of A 302-B and A 533-B reference plates from PSF simulated surveillance and through-wall irradiation capsules.** Hawthorne, J.R.; Menke, B.H.; Hiser, A.L. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Apr 1984. 114p. (MEA—2017-Vol.1). NTIS, PC A06/MF A01 - GPO* $5.00. Order Number DE84901099.

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Mechanical properties data have been developed for two of the materials: the ASTM A302-B correlation monitor reference plate and the A533-B plate No. 03 from the NRC's Heavy Section Steel Technology Program. These results are presented together with an overview of specimen irradiation and testing procedures. Data comparisons are used to describe the observed toughness gradient produced by irradiation where fluences were typical of vessel end-of-life conditions. In addition, assessments are made of the relative irradiation effect at surveillance capsule vs. through-wall locations and the correspondence of Charpy-V vs. fracture toughness test methods in their independent descriptions of radiation-induced embrittlement. Irradiation in the simulated surveillance capsule location was found to reproduce reasonably well the irradiation effect to vessel inner surface and quarter wall thickness positions. As expected, the adjustment of the ASME lower bound (i.e., dynamic) K/sub IR/ toughness curve by the radiation induced elevation of the Charpy-V 41 J and the compact specimen 100 MPa $\sqrt{m}$ temperatures was conservative when compared against the static toughness data. However, the temperature elevation of the C/sub v/ curve (41 J level) with irradiation frequently did not provide a conservative estimate of the temperature elevation defined by fracture toughness tests (100 MPa $\sqrt{m}$ level). On the other hand, correction of the fracture toughness data for lack of test specimen constraint (β/sub Ic/-correction) results in transition temperature elevations less than the C/sub v/ 41 J elevations, in most cases. Overall, the toughness gradient observed between in-wall locations after irradiation was small for both materials; the difference between transition temperatures for wall surface vs. mid thickness locations was 31°C or less, independent of the test method used. Candidate areas for future research investigation are discussed.

26332 **(NUREG/CR—3295-Vol.2) Light water reactor pressure vessel surveillance dosimetry improvement program. Volume 2. Postirradiation notch ductility and tensile strength determinations for PSF simulated surveillance and through-wall specimen capsules.** Hawthorne, J.R.; Menke, B.H. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Apr 1984. 143p. (MEA—2017-Vol.2). NTIS, PC A07/MF A01 - GPO* $5.50. Order Number DE84901094.

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The Program as irradiated mechanical property test specimens of several steels in a pressure vessel wall/thermal shield mock-up facility part of a broad NRC effort to develop key neutron physics-dosimetry-metallurgy correlations for making highly accurate projections of radiation-induced embrittlement to reactor vessels. The steels studied represent a wide range of radiation embrittlement sensitivities and include plates, forgings and submerged arc weld deposits (two each). This report presents notch ductility and tensile properties information developed with specimen irradiations at simulated surveillance and in-wall locations. The irradiations were conducted at 288°C; neutron fluences were typical of vessel end-of-life conditions. Data comparisons are used to illustrate the toughness gradient produced by irradiation and to assess the relative irradiation effect at surveillance vs. throughwall positions. The postirradiation toughness gradient between vessel surface and midwall locations was small (31°C or less) for five of the six materials. Tensile test observations support the notch ductility trend indications. Simulated surveillance capsule irradiations reproduced reasonably well the embrittlement at vessel inner surface and quarter wall thickness positions in almost all cases. The primary exceptiosn to both trends were provided by the steel having the highest embrittlement sensitivity (0.23% Cu, 1.58% Ni weld deposit). Aggregate results for this material suggest an independent contribution of high (> 1%) nickel contents to radiation sensitivity development and a weld susceptibility to long term time-at-temperature effects.

26333 **(NUREG/CR—3740) J-integral tearing instability analyses for 8-inch diameter ASTM A106 steel pipe.** Vassilaros, M.G.; Hays, R.A.; Gudas, J.P.; Joyce, J.A. (David W. Taylor Naval Ship Research and Development Center, Annapolis, MD (USA)). Apr 1984. 121p. NTIS, PC A06/MF A01 - GPO* $4.75. Order Number DE84900940.

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An experimental investigation was performed to evaluate the applicability of using J-Integral tearing instability analysis to describe the fracture behavior of 8-inch diameter, nuclear grade, ASTM A106 steel pipe. J-Integral tests were performed on 1/2 T, 1 T, and 2 T plan compact specimens and compared to pipe bend tests. Two different J-Integral analyses were used to describe fracture behavior. In one analysis, the material was modelled by assuming elastic-perfectly plastic behavior, while a second analysis utilized measurements of mechanical response of the loaded structure including hardening of the steel. A series of nine fracture tests were performed on the 8-inch diameter pipes with computerized data acquisition of load, deflection and crack length. Crack lengths were measured using elastic compliance, and direct current potential drop techniques simultaneously. Evaluation of the J-Integral tearing instability analysis was performed using J versus T plots of each

test. Results indicate that compact specimen J/sub I/-R curve test results agree with the J/sub I/-R curves from full size pipe bend tests. Further, J-Integral tearing instability analysis can accurately describe the ductile tearing behavior of 8-inch ASTM A106 steel pipe provided the actual load, displacement, crack length and hardening behavior is available. Such an analysis with assumed elastic fully plastic behavior appears to produce conservative results.

26334 **(PNL—5013) Sputter-deposited metallic and ceramic coatings for heat engines. Work performed from October 1980 to September 1983.** Prater, J.T.; Moss, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011401.

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Progress in the development of metallic and ceramic coatings with improved high-temperature corrosion and erosion/wear resistance is reported. The objective was to develop coatings that would insure that future heat engines, notably gas turbines and diesels, would be able to operate efficiently on degraded fuel supplies. The majority of coatings investigated were prepared by sputter deposition. Research on sputter-deposited CoCrAlY coatings was directed at improving their low-temperature, hot corrosion resistance by introducing composition gradients and adding platinum. Studies on sputter-deposited ZrO_2 and Al_2O_3 coatings were conducted to improve the thermal cycling resistance of ceramic deposits on metal substrates by using combinations of graded transition layers, columnar ceramic structures, and dense sealing layers. Preliminary results on plasma-sprayed Ni-SiC and quartz-SiC coatings that showed good wear and oxidation resistance are also reported.

26335 **(PNL-SA—12159) Heterogeneous growth in transition metal/rare earth films during bias sputter-deposition.** Knoll, R.W.; McClanahan, E.D.; Kjarmo, H.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 18p. (CONF-8404135—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010780.

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1908).

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In the presence of certain defects that acts as nucleation sites, large oriented precipitates formed in thick Ni-La and Ni-Y films that were deposited at substrate biases of several hundred volts. Films deposited with no bias were amorphous or were very homogeneous. Both the unbiased and biased films were produced by high-rate sputter-deposition in a thermionically supported Kr discharge. Application of substrate bias resulted in intense Kr^+ ion bombardment of the growing films. Preferential resputtering of the RE component and enhanced atomic mobility at the growth surface, combined with the mutual insolubility of the Ni and RE components, are thought to have produced these growths. Examples of the heterogeneous microstructures are presented and discussed here.

26336 (RL—83-069, pp vp) **Low cycle fatigue of 316 s/steel at 350-550 deg C.** Faulkner, R.G.; Chung, T.E. (Loughborough Univ. of Technology (UK). Dept. of Materials Engineering and Design). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

A brief statement is presented of intended work under the headings: mechanical testing; microstructural evaluation. Theoretical isothermal precipitation curves are shown for intergranular $M_{23}C_6$ and TiC in 18/8 austenitic steel (321 type).

26337 (RL—83-069, pp vp) **Vacancy formation and migration energies in strained crystals.** Bacon, D.J.; Matthai, C.C. (Liverpool Univ. (UK). Dept. of Metallurgy and Materials Science). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

Computer simulation is being used to investigate the structure and properties of defects in metals produced by radiation damage. Two aspects have been studied to date, namely (a) the formation energy and mobility of vacancies in strained crystals and (b) the factors influencing the crystallography of vacancy loops in body-centred-cubic metals. The former, which is discussed in the present paper, is related to the properties of vacancies in displacement cascades. Rather than consider the complicated distortions within cascades, simple homogeneous strain has been used with the aim of comparing the results of different forms of interatomic potential. The formation and migration energies of vacancies in hydrostatically-strained model f.c.c. and b.c.c. crystals have been calculated using equilibrium and non-equilibrium potentials for iron, molybdenum, copper and nickel.

26338 (RL—83-069, pp vp) **Crystallography of vacancy loops in body-centred-cubic metals.** Bacon, D.J. (Liverpool Univ. (UK). Dept. of Metallurgy and Materials Science). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

Computer simulation is being used to investigate the structure and properties of defects in metals produced by radiation damage. Two aspects have been studied to date, namely (a) the formation energy and mobility of vacancies in strained crystals and (b) the factors influencing the crystallography of vacancy loops in body-centred-cubic metals. The former is related to the properties of vacancies in displacement cascades and is discussed in a separate paper. The second problem, which is dealt with in the present paper, arises from the observation that vacancy loops in some b.c.c. metals, e.g. molybdenum, have Burgers vectors 1/2 <111>, whereas in iron, a high proportion of loops have <100>. Both forms are believed to evolve from the same nucleus, namely, a faulted vacancy disc with Burgers vector 1/2 <110> on the brace 110 brace planes. Since the brace 110 brace stacking fault is believed to be unstable, it is hoped that computer simulation can be used to investigate the factors influencing the shearing mechanisms which lead to the final loop geometry. Equilibrium potentials which give reasonable fits to the elastic constants of iron and molybdenum are being employed to determine the characteristics of collapse due to the possible shears of vacancy loops on brace 110 brace planes. For simplicity, vacancy dipoles of various spacings have been considered initially, and the work is now being extended to finite loops.

26339 (RL—83-069, pp vp) **Relation between neutron and proton irradiation damage structures in metals.** Cawley, J.; Eyre, B.L.; Jaeger, D.; Earwaker, L. (Liverpool Univ. (UK)). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

It is important to develop simulation techniques for assessing radiation damage, that can be compared directly with the practical case of first wall fusion reactor components and thus predict the damage structures resulting from the high energy radiation involved. The project is concerned with the detailed quantitative analysis of the irradiation structures developed when using 3 MeV protons as the radiation source. The project to date has concentrated on developing the proton accelerator target chamber. Further, irradiations of copper have been carried out and preliminary transmission electron microscope studies have been carried out of the damage structures. Plans for future work are outlined.

26340 (RL—83-069, pp vp) **Assessment of materials for fusion reactors.** Griffiths, M.; Loretto, M.H.; Smallman, R.E. (Birmingham Univ. (UK). Dept. of Physical Metallurgy and Science of Materials). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

Titanium of not < 99.9% purity has been irradiated with protons, electrons and neutrons over a range of temperature from 0.3 Tm < T < 0.4 Tm. The microstructure of these irradiated samples is currently being investigated using TEM and the results available to date are summarised briefly.

26341 (RL—83-069, pp vp) **Growth of cavities during irradiation.** Luklinska, Z.H.; Goodhew, P.J.; Waldron, M.B. (Surrey Univ., Guildford (UK). Dept. of Metallurgy and Materials Technology). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

The major aim of this programme is to investigate the mobility and growth of small helium gas bubbles in steels in the presence of displacement damage. The first experiments have been designed to determine the kinetics and rate-controlling processes for the growth of such bubbles in the absence of displacement damage. This stage of the work has been undertaken by helium implantation and is nearing completion. The kinetics of bubble migration have been determined in both 316 steel and a ferritic/martensitic FI steel. A brief statement on the experiments and the results is presented, and the next step, adding displacement damage, is outlined.

26342 (RL—83-069, pp vp) **Channelling studies of defect-impurity interactions in fusion technology metals and alloys.** Palmer, D.W.; Kijek, M. (Sussex Univ., Brighton (UK). Physics Div.). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

An outline is presented of a proposed investigation into the physical parameters of the trapping of lattice defects (especially self-interstitials and vacancies) at impurity atoms dissolved in body-centred cubic α-iron. The measurements will use the technique of light-ion (proton and helium ion) channelling at low temperatures in single-crystal α-iron.

26343 (RL—83-069, pp vp) **Investigation of the effects of irradiation on the microstructure and properties of commercially produced Nb_3Sn.** Rawlings, R.D.; Holdway, P. (Imperial Coll. of Science and Technology, London (UK). Dept. of Metallurgy and Materials Science). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

A summary is presented of the microstructure and mechanical properties of Nb_3Sn tape after irradiation with fast neutrons. Specimens were variously annealed. Examination by TEM showed dislocation loops. Post-irradiation annealing resulted in increased grain size. Young's modulus, shear modulus and tensile fracture stress are reported.

26344 **(SAND—83-1690C) Creep-fatigue and temperature synergisms in alloy 800.** Jones, W.B. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 17p. (CONF-840218—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010131.

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

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Alloy 800 from three different commercial heats have been continuously cycled and cycled with a hold period at 922°K. The starting microstructures of these heats reflects an inherently wide spectrum of possibilities for Alloy 800. The amounts and morphologies of the TiC and $M_{23}C_6$ carbides are different among the heats. During cycling, $M_{23}C_6$ forms intragranularly in a solution annealed heat. This precipitation contributes to the cyclic hardening. Both mill annealed heats of Alloy 800 are stable to carbide precipitation during cycling. The heat with the lower carbon content formed γ' during cycling but the volume fraction was too low to contribute to hardening. The inclusion of hold periods caused the dislocation substructure to become more diffuse in the mill annealed heats. The cyclic hardening was enhanced with the inclusion of the hold periods but this was not due to any microstructural change during testing.

26345 **(SAND—84-8221) Experimental research facility for creep-rupture testing of tantalum alloy T-111.** Kawahara, W.A.; Schoeneman, B.D.; Korellis, J.S. (Sandia National Labs., Livermore, CA (USA)). May 1984. Contract AC04-76DR00789. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012030.

We have developed a research facility for computer-controlled elevated temperature tensile testing of refractory metallic alloys in an inert enviroment. In an application to tantalum alloy T-111, we have determined that a two-hour creep rupture life can be achieved at 1204°C (0.45 T/sub m/) and 1300°C (0.48 T/sub m/) if the applied true stresses are maintained below 46 ksi (317 MPa) and 36 ksi (248 MPa), respectively.

26346 **(UCID—20002) Galvanic corrosion of an aluminum O-ring.** Truhan, J.J.; Chen, C. (Lawrence Livermore National Lab., CA (USA)). 30 Mar 1984. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011345.

The purpose of this study was to estimate the extent of galvanic corrosion occurring between the components of a metal O-ring. The O-ring consists of a split toroid composed of 1050 Al and the internal component, which is a 750X Inconel spring that provides the elasticity. The galvanic measurements were made in deionized water to simulate humid conditions and in a 1% NaCl aqueous solution to simulate the acceleration in corrosion that may occur if surface contamination due to handling or inadequate cleaning is present on the surface.

26347 **(UCRL—15585) Phase transformation and the equation of state of beryllium (Be) under high pressure. Final report.** Ming, L.C.; Manghnani, M.H. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Jan 1983. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010987.

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The lattice parameters (a,c) and molar volume of Be have been determined up to 30 GPa at ambient temperature. Assuming the ultrasonic value of $K_o' = 4.6$, we obtain $K_o = 114$ GPa from the pressure-volume data. This voluem is in good agreement with both the ultrasonic value (111 GPa) and the shock wave value (118 GPa). The effect of pressure on the axial ratio of c/a is small; at pressures up to $\sim$ 30 GPa, the value of c/a decreases only $\sim$ 0.2%. Investigation of phase transition(s) in Be at 28.3 GPa shows that at pressures between 8.6 GPa and 14.5 GPa the hcp phase transforms into a distorted hcp phase with a very slight volume change ($< 0.5\%$). The distorted hcp phase has a simple relationship with the hcp phase, that is: a = 2a/sub hcp/ and c $\approx$ c/sub hcp/.

26348 **(UCRL—53468) Simulations of erosion/corrosion surface chemical reactions with a laser beam.** Price, C.W. (Lawrence Livermore National Lab., CA (USA)). 1 Nov 1983. Contract W-7405-ENG-48. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011621.

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Surface chemical reactions in highly transient reactive environments frequently contribute to material degradation and subsequent loss by erosion/corrosion mechanisms. An attempt was made to simulate these reactions with a pulsed laser system in a pressure chamber. Gaseous carburizing and nitriding reactions were studied because of their frequent occurrence in erosion/corrosion environments. Reactions in pure iron and AISI 4340 steel were characterized by secondary ion mass spectroscopy (SIMS), optical metallography, and scanning electron microscopy (SEM). Gases used for laser-pulsing included argon, methane, carbon monoxide, ammonia, and nitrogen. The effect of gas pressure also was investigated. The results demonstrate that significant amounts of the reactive species can be driven into metal surfaces if the energy of the laser pulse exceeds the threshold for surface melting to occur. Specimen response appears to be reproducibly sensitive to the environment even in the relatively short time frame of the 600-μs laser pulse. Tests also were performed on AISI 4340 steel specimens coated with tungsten to demonstrate the capability of the laser system to test candidate coating materials.

26349 **(UCRL—53504) Corrosion of 5083 aluminum by aqueous sodium sulfate.** Chen, C.; Truhan, J.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1983. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012033.

Electrochemical techniques were used to determine the corrosion rate of 5083 aluminum in sodium sulfate solution, and correlated the results with findings from standard metallographic examination. The corrosion rate measured by linear polarization was low: less than 1 mil/y for temperatures ranging from 23 to 70°C and deaerated concentrations from 1 to 30 g/l. The corrosion current varied over these ranges by about one order of magnitude. Increasing concentrations and temperatures produced increasing current, as expected; temperature had a stronger effect than concentration on the corrosion rate, however. Potentiodynamic polarization curves obtained at the above ranges of temperature and concentration showed the quasi-active-passive behavior typical of aluminum alloys in salt solutions. The curves were qualitatively similar for all of the experimental conditions. As the concentration and temperature increased, the rest potential became more active, and the average passive current similarly increased. As in the linear-polarization measurements, the current varied by about one order of magnitude over all conditions. In order to identify the mode of attack, we used a scanning electron microscope to examine samples anodically polarized for 1 h at 70°C and 30 g/l. The attack was uniform, and there was no evidence to suggest localized attack. Energy-dispersive x-ray analysis showed no less of magnesium as the alloy was increasingly anodically polarized. We conclude that the primary corrosion mechanism in sodium sulfate solution is uniform attack on the aluminum matrix, without preferential attack of the beta phase (Al_2Mg_3).

26350 **(UCRL—89002) Defect production efficiencies in thermal neutron irradiated copper and molybdenum.** Kinney, J.H.; Guinan, M.W.; Munir, Z.A. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). 24 Apr 1984. Contract W-7405-ENG-48. 6p. (CONF-830942—85). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010993.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

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We have derived the primary recoil spectra for thermal neutron capture in copper and molybdenum, and have calculated the damage energy cross-sections needed to determine the defect production efficiencies from measured resistivity damage rates. These efficiencies, which are in excellent agreement with fully dynamic computer simulations of collision cascades, are compared to the predictions of displacement functions which are currently in use.

26351 **(Y/DV—304) Microstructural analysis for series 300 stainless steel sheet welds and tensile samples.** Gray, R.J.; Holbert, R.K. Jr.; Thrasher, T.H. (Oak Ridge National Lab., TN (USA); Oak Ridge Y-12 Plant, TN (USA)). 4 Jan 1984. Contract AC05-84OS21400. 30p. (CONF-830759—4). NTIS MF A01; 2; GPO Dep. Order Number DE84008513.

From 16. annual technical meeting of the International Metallographic Society; Calgary, Canada (25 Jul 1983).

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The hot cracking susceptibility of some 300 series stainless steel welds can be minimized by the presence of a small amount of delta ferrite in the microstructure. The identification and location of the delta ferrite require a highly sensitive procedure. A similar challenge is involved in the resolution of strain-induced martensite. Hagnetic etching, which involves the use of an iron colloid solution in a controlled magnetic field, meets many of the demands for resolving these ferromagnetic features in the microstructure. The technique produces an analog pattern with the colloid that is observed in-situ with the conventionally etched microstructure and offers high resolution analysis of the ferromagnetic delta ferrite and martensite in the paramagnetic austenitic matrix. The technique, which can be applied to the upper limit of the magnification of an optical metallograph, is described. 14 figs.

26352 **Fooling Mother Nature: ion beam and laser techniques improve materials.** Appleton, B.R. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 2-10(Fal 1983).

The use of ion beams and laser light to alter surfaces and thus change their properties are discussed. Using these techniques, semiconductor alloys have been produced for use in electronic devices, tougher ceramics for possible use in high-temperature engines, and corrosion-resistant alloys for possible use in artificial hip joints. The following topics are discussed: materials processing, ion implantation doping, ion beam mixing, pulsed laser processing, new properties, and supersaturated alloys.

26353 **Welding metals and alloys.** David, S.A. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 106-110(Fal 1983).

Welding is the art and science of joining metals, usually by heating them to a suitable temperature. A review of the development of modern welding technology is presented. The Oak Ridge National Laboratory's program for advancing the science and technology of welding is described. ORNL research programs have produced improved weld metals, optimized their properties, and developed welding processes and procedures to make better transition joints. The ORNL program is discussed under three headings: stainless steel welds, residual elements, and transition joints.

26354 **Characterizing materials by x-ray.** Borie, B. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 16-21(Fal 1983).

Diffraction crystallographers have known how to use x-rays to determine exactly the repeating pattern of atoms that makes up a crystal for many years. The study of atomic structure of matter by x-ray diffraction at the Oak Ridge National Laboratory is discussed. Many contributions to the development of this discipline, including new ways to gather the data, new methods for their interpretation, and computer techniques for their manipulation and representation had their origins at ORNL. Changes in research directions and kinds of studies to be undertaken, mainly because of the availability of x-radiation from synchrotrons, are discussed.

26355 **Neutron scattering in materials research.** Nicklow, R.M. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 22-27(Fal 1983).

Since the late 1940's, neutron scattering research has grown tremendously and has become an important source of experimental information about the structural, magnetic, and dynamical properties of materials at the microscopic level. Neutron scattering experiments at ORNL are discussed. Studies on the structure of water, the ways in which water reduces the performance of solid electrolytes in experimental batteries, the magnetic ordering of copper-manganese crystals, atomic bonding forces in crystals, and the structure of uranium crystals at very low temperatures are reviewed.

26356 **Characterizing materials by analytical electron microscopy.** Bentley, J. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 28-33(Fal 1983).

Through an understanding of the relationships between properties and microstructure, principles can be developed for the design of advanced materials that have superior properties. Analytical electron microscopy is an important technique that provides detailed microstructural characterization used in making these structure-property correlations. Analytical electron microscopy is used at the Oak Ridge National Laboratory to understand how microstructure affects properties. The goal of the research is to develop principles for the design of alloys that have superior properties, such as high resistance to radiation damage. The research being done at ORNL on analytical electron microscopy is reviewed.

26357 **Design of ordered intermetallic alloys.** Liu, C.T. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 38-41(Fal 1983).

Many advanced heat engines and energy conversion systems must be operated at reduced temperatures because of inadequate performance of current structural materials at high temperatures. Thus, these engines and power plants are not as efficient as they could be. Therefore, there is a pressing need to develop innovative materials for structural service at elevated temperatures. Recently, significant achievements have been made in the Metals and Ceramics Division of the Oak Ridge National Laboratory in the design and development of a new class of structural materials based on ordered intermetallic alloys. Research efforts in the design of an ordered nickel aluminide with superior properties are reviewed.

26358 **Mechanical properties of metals and alloys.** Ohr, M.; Yoo, M. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 50-51(Fal 1983).

Material failure by fracture is one of the most serious technological problems encountered in energy systems. Research programs at the Oak Ridge National Laboratory have emphasized the understanding of the basic mechanisms of material failure and the approach has been primarily the characterization of microstructure and the relationship of microstructure to bulk mechanical behavior of materials. Research activities in the Solid State Division in understanding material failure are briefly discussed.

26359 **On the surface.** Wendelken, J.F. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 14-15(Fal 1983).

Many of the interactions of materials used by nature and man to shape and reshape the material world occur at surfaces. The study of surfaces did not become popular until the last two decades. Because a surface reacts with its environment, the study of surfaces first requires the ability to control that environment. This ability has been acquired as a result of the development of ultrahigh vacuum chambers and techniques for producing clean, well-characterized surfaces. Research at the Oak Ridge National Laboratory on surface science is discussed.

26360 **Solid state physics theory.** Mostoller, M.; Cooke, J. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 36-37(Fal 1983).

Research activities in the Solid State Division of the Oak Ridge National Laboratory are reviewed. At present, this research may be grouped into four areas: surfaces, electronic, magnetic, and virbrational properties, particle-solid interactions, and laser annealing. Each of these areas is discussed briefly.

26361 **Theory of alloys: from the Schroedinger equation to the rolling mill.** Stocks, M. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 42-49(Fal 1983).

Recent developments in alloy theory are making it possible to calculate alloy properties, understand mechanisms that control properties, and guide the development of alloys with superior properties for technological applications such as high-temperature energy systems. Research activities at the Oak Ridge National Laboratory in the development of new and useful alloys systems and the elucidation of their properties are described.

26362 **Marketing ORNL-made materials.** Krause, C. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 52-57(Fal 1983).

The development and application of new energy-related materials at the Oak Ridge National Laboratory are discussed. In recent years, ORNL has developed a low-swelling steel, a modified chromium-molybdenum alloy, a modified nickel aluminide, and highly-efficient laser-processed silicon solar cells. The transfer of the technology for producing these materials from the laboratory to the marketplace is discussed.

26363 **Toward a high-temperature materials laboratory.** Tennery, V.J. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 88-92(Fal 1983).

The Oak Ridge National Laboratory has proposed that a national research center be established at ORNL devoted to research on and development of heat-resistant materials for applications to energy production and conservation. The High-Temperature Materials Laboratory (HTML), which was included in DOE's fiscal year 1984 budget is scheduled to be built at ORNL by 1988 or 1989. A summary of ORNL's efforts to obtain funding for the HTML is presented.

26364 **Corrosion studies at ORNL.** Cathcart, J.V. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 115-116(Fal 1983).

Materials are useless unless they can be made reasonably compatible with their operating environments in high-temperature energy systems. The Oak Ridge National Laboratory's program for studying corrosion, both applied and fundamental, is described. This program is dedicated to studying ways of reducing corrosion and to selecting materials that are resistant to corrosion. A brief review of ORNL's activities in corrosion research since the 1950s is presented.

26365 **Compositional redistribution in alloy films under high-voltage electron microscope irradiation.** Lam, N.Q. (Argonne National Lab., IL (USA). Materials Science Div.); Leaf, G.K.; Minkoff, M. (Argonne National Lab., IL (USA). Applied Mathematics Div.; Argonne National Lab., IL (USA). Computer Science Div.). *Journal of Nuclear Materials;* **118**: No. 2/3, 248-259(Sep-Oct 1983).

With 30 refs.

The problem of nonequilibrium segregation in alloy films under high-voltage electron microscope (HVEM) irradiation at elevated temperatures is re-examined in the present work, taking into account the damage-rate gradients caused by radial variation in the electron flux. Axial and radial compositional redistributions in model solid solutions, representative of concentrated Ni-Cu, Ni-Al and Ni-Si alloys, were calculated as a function of time, temperature, and film thickness, using a kinetic theory of segregation in binary alloys. The numerical results were achieved by means of a new software package (DISPL2) for solving convection-diffusion-kinetics problems with general orthogonal geometries. It was found that HVEM irradiation-induced segregation in thin films consists of two stages. Initially, due to the proximity of the film surfaces as sinks for point defects, the usual axial segregation (to surfaces) occurs at relatively short irradiation times, and rapidly attains quasi-steady state. Then, radial segregation becomes more and more competitive, gradually affecting the kinetics of axial segregation. At a given temperature, the buildup time to steady state is much longer in the present situation than in the simple case of one-dimensional segregation with uniform defect production. Changes in the alloy composition occur in a much larger zone than the irradiated volume. As a result, the average alloy composition within the irradiated region can differ greatly from that of the unirradiated alloy. The present calculations may be useful in the interpretation of the kinetics of certain HVEM irradiation-induced processes in alloys.

26366 **Tritium production and distribution in a Zircaloy-clad Li_7Pb_2 assembly irradiated in the Oak Ridge Research Reactor.** Clemmer, R.G.; Gohar, Y.; Greenwood, L.R.; Hall, M.M.; Hins, A.G.; Krsul, J.R.; Mattas, R.F.; Summers, J.R.; Maroni, V.A. (Argonne National Lab., IL (USA)); Senn, R.L. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials;* **118**: No. 2/3, 275-285(Sep-Oct 1983).

A specimen of Li_7Pb_2 (lithium in natural abundance) contained in a Zircaloy capsule was irradiated in the Oak Ridge Research Reactor Poolside Facility for approx.= 700 h. The design of the irradiation assembly (designated TBC-07) permitted operational control of the breeder material at a temperature of (390 +- 25)°C throughout the irradiation. The amount of tritium determined to be present in the capsule parts during post-irradiation chemical analysis was (52 +- 5) Ci, corresponding to the burnup of approx.= 8% of the original ^6Li in the capsule. The estimated tritium production based on simple neutronics calculations, using an assumed total flux of 1.2×10^{14} neutrons/cm^2 s, was approx.= 56 Ci. The value derived from a limited dosimetry measurement on the TBC-07 thermocouple wire was approx.= 80 Ci. The axial tritium distribution profile along the Zircaloy capsule wall and the Li_7Pb_2 cylinder indicated a nonuniform temperature during irradiation, with the capsule ends probably being at lower temperature than the center

region. There was no evidence of tritium loss from the experiment during or after irradiation. Metallurgical analysis of the Li_7Pb_2 after irradiation revealed the presence of a unique network of hexagonal bubbles wherein facets are preferentially aligned along crystallographic planes and are also rich in lithium.

26367 Deposition of model crud on boiling zircaloy surfaces at high temperature. Kawaguchi, M.; Fujita, N.; Ishigure, K.; Oshima, K. (University of Tokyo Department of Nuclear Engineering, Faculty of Engineering, Tokyo). *Nuclear Technology;* **62**: No. 3, 253-262(Sep 1983).

The deposition experiments were carried out under high pressure (7 MPa) at 285°C using model compounds (-hematite) to investigate the deposition process of crud on boiling surfaces. The effects of several factors, such as the diameter of the model particles (0.15 to 2.3 μm), pH (7 to 13), and heat flux of the heated surfaces (5 to 16 W/cm²), on the deposition rate during the initial stage were investigated. It was found that the deposition rate of the hematite particle, having a narrow particle size distribution, strongly depends on the particle diameter and pH of the crud suspension. An explanation of these results was based on the assumption that the electrokinetic interaction between the particle and the surface plays an important role in the deposition process of the crud particles. Furthermore, it was found that the deposition rate of the hematite, having a narrow particle size distribution, deviates from the linear proportionality.

26368 Single-ion and pair-interaction potentials near simple metal surfaces. Barnett, R.N.; Barrera, R.G.; Cleveland, C.L.; Landman, U. (Georgia Inst. of Tech., Atlanta). *Physical Review* [*Section*] *B: Solid State;* **28**: No. 4, vp(15 Aug 1983).

Presented is a model for semi-infinite simple metals which does not require crystalline order or a single species, and thus is applicable to problems of defect energetics near the surface and random-alloy surfaces as well as ideal metal surfaces. The formulation is based on the use of ionic pseudopotentials and linear-response theory. An expression for the total energy is obtained which depends explicitly on ionic species and position. This expression is decomposed into a density-dependent term and single-ion and ionic pair-interaction potential terms. The single-ion potentials oscillate about a constant bulk value, with the magnitude of the oscillation decreasing rapidly away from the surface. The interaction between pairs of ions near the surface is shown to be a noncentral force interaction which differs significantly from the central-force bulk pair potential. The effect of quantum interference in the response of the semi-infinite electron gas to the ions is seen in both the single-ion and the pair-interaction potentials. Results are presented for the simple metals sodium, potassium, and rubidium.

26369 Method for fabricating laminated uranium composites. Chapman, L.R. (to Dept. of Energy). US Patent Application 6-519,873. 3 Aug 1983. 10p. Contract AC05-84OR21400.

The present invention is directed to a process for fabricating laminated composites of uranium or uranium alloys and at least one other metal or alloy. The laminated composites are fabricated by forming a casting of the molten uranium with the other metal or alloy which is selectively positioned in the casting and then hot-rolling the casting into a laminated plate in or around which the casting components are metallurgically bonded to one another to form the composite. The process of the present invention provides strong metallurgical bonds between the laminate components primarily since the bond disrupting surface oxides on the uranium or uranium alloy float to the surface of the casting to effectively remove the oxides from the bonding surfaces of the components.

26370 Ductile aluminide alloys for high temperature applications. Liu, C.T.; Kock, C.C. (to Dept. of Energy). US Patent Application 6-519,941. 3 Aug 1983. 9p. Contract AC05-84OR21400.

Heat- and corrosion-resistant alloys are described which contain nickel, aluminum, boron, iron and in some instances manganese, niobium and titanium.

26371 Magnetic coupling in granular aluminum superconducting films. Gray, K.E. (Argonne National Lab., IL). *Physical Review* [*Section*] *B: Solid State;* **28**: No. 3, 1281-1285(1 Aug 1983).

The maximum coupling force F/sub cm/ in a Giaever superconducting transformer is measured in granular aluminum films at significantly higher fields and lower temperatures than in previous work. A new method to determine F/sub cm/ by measuring the critical current in one film only is presented. The results are in excellent quantitative agreement with the one-reciprocal-lattice-vector approximation to the theoretical analysis in its region of validity, i.e., at high fields. For low fields, F/sub cm/ is consistent with the temperature dependence of the low-field approximation over the entire reduced-temperature (t = T/T/sub c/) range (0.36<t<0.96.

26372 Improved oxidation sulfidation resistance of Fe-Cr-Ni alloys. Natesan, K.; Baxter, D.J. (to Dept. of Energy). US Patent Application 6-517,474. 26 Jul 1983. 16p. Contract W-31-109-ENG-38.

High temperature resistance of Fe-Cr-Ni alloy compositions to oxidative and/or sulfidative conditions is provided by the incorporation of about 1 to 8 wt % of Zr or Nb and results in a two-phase composition having an alloy matrix as the first phase and a fine grained intermetallic composition as the second phase. The presence and location of the intermetallic composition between grains of the matrix provides mechanical strength, enhanced surface scale adhesion, and resistance to corrosive attack between grains of the alloy matrix at temperatures of 500 to 1000°C.

26373 Tantalum-copper alloy and method for making. Schmidt, F.A.; Verhoeven, J.D.; Gibson, E.D. (to Dept. of Energy). US Patent Application 6-500,102. 1 Jun 1983. 11p. Contract W-7405-ENG-82.

A tantalum-copper alloy can be made by preparing a consumable electrode consisting of an elongated copper billet containing at least two spaced apart tantalum rods extending longitudinally the length of the billet. The electrode is placed in a dc arc furnace and melted under conditions which co-melt the copper and tantalum to form the alloy.

26374 Improved mathematical model for melt flow in induction furnaces and comparison with experimental data. Evans, J.W. (Univ. of California, Berkeley); Lympany, S.D. *Metallurgical Transactions,* [*Section*] *B: Process Metallurgy;* **14B**: 306-308(Jun 1983). Contract AC03-76SF00098.

An improved mathematical model is described for studying electromagnetic stirring in induction furnaces or similar devices wherein currents are induced in a melt. The objective of these studies was to predict melt velocities, coupled with experimental measurements of velocity aimed at testing the model's predictions. The results of the studies suggest that better experimental data and improvements in the model may results in a much greater degree of confidence in such predictions.

26375 Multilayer lattice relaxation at metal surfaces. Barnett, R.N.; Landman, U.; Cleveland, C.L. (Georgia Inst of Tech., Atlanta). *Physical Review* [*Section*] *B: Solid State;* **27**: No. 10, 6534-6537(15 May 1983).

Relaxation at simple metal surfaces is studied via minimization of the total energy of a semi-infinite crystal. Systematic analysis of the contributions to the total energy demonstrates the importance of a proper, three-dimensional treatment of electronic response. Multilayer relaxation is shown to be essential for quantitative predictions. Results for the low-index faces of Na and for Al(110) are presented. Good agreement with detailed low-energy electron diffraction data for oscillatory multilayer relaxation in Al(110) is obtained.

26376 Surface versus shake-down effects in the deep-core photoemission of Sm- and Eu-based intermetallics. Raaen, S.; Parks, R.D. (Polytechnic Inst. of New York, Brooklyn). *Physical Review* [*Section*] *B: Solid State;* **27**: No. 10, 6469-6471(15 May 1983). Contract AC02-81ER10862.

Shakedown effects, due to final-state screening of a core level by a (localized) 4f electron, have frequently been reported in

x-ray photoemission spectroscopy core-level spectra of metallic systems based on the lighter rare-earth elements. Such effects appear to correlate with the hybridization between the 4f electrons and the conduction electrons, which decreases monotonically with increasing Z in the rare-earth series because of the lanthanide contraction of the 4f subshell. This picture has been clouded by the recent report of a large shakedown satellite in the 3d emission from $EuPd_3$, such an effect being absent in $SmPd_3$ and negligibily small in $NdPd_3$. A similar effect in $SmAl_3$, where the required hybridization is expected to be small has been observed, and the authors argue that in both cases the anomalous satellite is the emission from a divalent surface layer rather than a shakedown effect in the trivalent bulk.

26377 **Tritium permeability and pressure dependence of 304L stainless steel in the temperature range 723 to 1023 K.** Matsuyama, M. (Toyama Univ., Japan); Redman, J.D. *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **14A**: 498-500(Mar 1983).

Knowledge of tritium permeability is important to the development of the nuclear fission and the thermonuclear reactor systems. Numerous investigations concerning permeability and diffusivity of hydrogen isotopes for various metals and alloys have been reported. In recent papers, it has been reported that oxide layers formed on the surfaces of alloys markedly affected the permeation of tritium, and also that both the permeability constant and the activation energy for tritium permeation were different for nonoxidized austenitic steels and ferritic steels. Tritium permeation through 304L stainless steel, which has one of the lowest nickel and carbon contents of the austenitic steels, had not been measured and was the subject of the present study.

26378 **Effects of antimony additions on the fracture of nickel at 600°C.** White, C.L.; Padgett, R.A. (Oak Ridge National Lab., TN). *Acta Metallurgica;* **31**: No. 7, 1005-1012(1983). Contract W-7405-ENG-26.

Antimony additions (≈ 1 wt%) are found to drastically lower tensile ductility and induce extensive intergranular cracking in nickel at 600° C. This effect is most pronounced at lower strain rates. These results are contrasted to results for pure nickel where ductility is high and failure occurs via plastic instability. Scanning electron microscopy revealed faceting of crack and cavity surfaces in the antimony doped nickel. Auger electron spectroscopy revealed segregation of antimony and (residual) sulfur to both grain boundaries and to the internal free surfaces of cracks and cavities. Inert ion sputter profiling showed that most of the antimony and sulfur enrichment of these surfaces is confined within a few atom layers of the interface. The embrittling influence of antimony is discussed in terms of the observed antimony and sulfur segregation to internal interfaces. Possible connections between the segregation and the observed embrittlement involve segregation effects on grain boundary sliding, grain boundary and surface diffusivities, and interfacial energetics.

26379 **Effect of thickness on plastic zone size in BCS theory of fracture.** Chang, S.J.; Ohr, S.M. (Oak Ridge National Lab., TN). *International Journal of Fracture;* **21**: 3-13(1983). Contract W-7405-ENG-26.

In the fracture theory of Bilby, Cottrell and Swinden, the plastic zone in an infinitely thick specimen was represented as a distribution of dislocations. For a specimen of finite thickness, Eshelby and Stroh have shown that the interaction force between two screw dislocations can be expressed by a modified Bessel function which decays much faster than the inverse first power law as the distance between the dislocations is increased. By assuming a continuous distribution of dislocations, an integral equation based on the Eshelby and Stroh interaction is formulated to examine the effect of thickness on the plastic zone size as well as the relative displacement along the crack surfaces. The distribution function of dislocations is obtained numerically from this integral equation. Numerical results indicate that for a given crack opening displacement the length of t numerically from this integral equation. Numerical results indicate that for a given crack opening displacement the length of the plastic zone decreases with decreasing specimen thickness. Energy release rate is discussed from the dislocation point of view. A previous result that the energy release rate is equal to the total force on the dislocations in the plastic zone is generiew. A previous result that the energy release rate is equal to the total force on the dislocations in the plastic zone is generalized to the case of a plate with finite thickness.

26380 **Internal Friction study of solute segregation to dislocations.** Schwarz, R.B.; Funk, L.L. (Argonne National Lab., IL). *Acta Metallurgica;* **31**: No. 2, 299-315(1983).

Internal Friction (IF) techniques operating at a frequency of 1.3kHz were used to measure the solution hardening component of the flow stress as a function of temperature, static aging time, and solute concentration in single crystal alloys of Al-Mg and Cu-Al. During the IF tests most of the dislocations remained in their aged condition. A small fraction of the dislocation density was set free from their solute cloud by the application of a sufficiently large periodic stress. The kinetics of solute segregation to the freed dislocations was then monitored with the IF method. The experimental results were interpreted in terms of recent computer-modeling calculations for IF losses in random alloys. The kinetics of solute segregation shows three regimes. At low temperatures the dislocations interact with a fixed population of solutes. At intermediate temperatures solutes segregate to stationary dislocations mostly from the region surrounding the dislocation cores, without the assistance of an excess concentration of vacancies generated by plastic deformation. At high temperatures the segregation reaches a saturation value because the solutes tend to remain in solution, rather than segregate to dislocations.

26381 **Magnetic properties of $HfZn_2$.** Radousky, H.B.; Knapp, G.S.; Downey, J.W.; Aldred, A.T.; Freeman, A.J. (Argonne National Lab., IL). *Journal of Magnetism and Magnetic Materials;* **40**: 117-120(1983).

$HfZn_2$ is known to be an exchange enhanced paramagnet, with a strongly temperature dependent susceptibility. In a new study, a sample of $HfZn_2$ has been prepared, which is even more strongly enhanced and hence closer to ordering ferromagnetically than found in a previous study. The values of the electronic contribution to the specific heat, the magnetic susceptibility at T = 0, chi(0) and the Stoner exchange enhancement factor S = 1/[N(E/ sub F/)I - 1] have all been found to increase substantially compared to earlier results.

26382 **Dynamic recrystallization and dynamic recovery in <111> single crystals of nickel and copper.** Gottstein, G.; Kocks, U.F. (Argonne National Lab., IL). *Acta Metallurgica;* **31**: 175-188(1983).

The characteristics of dynamic recrystallization in <111> single crystals of nickel were investigated and compared to those in copper. The results are correlated with macroscopic parameters of strain hardening and dynamic recovery. It was found that the temperature dependence of the critical stress for dynamic recrystallization can be described by the same form as that of the extrapolated steady-state flow stress; the two stresses are proportional to each other in the range of temperatures from 0.5 to 0.75 T/sub m/, and are equal above 0.75 T/sub m/. The transition temperature, which is rather sharply defined, corresponds also to a transition in strain-hardening behavior. Thus, dynamic recrystallization seems to be controlled by deformation behavior, and it is through this that the stacking-fault parameter chi/sub SF/μb becomes important; it makes Ni more like Cu than Al. A change in the substructures observed both before and after dynamic recrystallization occurs at the same transition temperature. In the medium-high temperature regime (0.5 ≦ T/T/sub m/<0.75), the deformation structure consists of cell walls with some incipient subboundary sections; during dynamic recrystallization, twins are apparently emitted from the latter, perhaps owing to high local internal stresses. At very high temperatures (T>0.75 T/sub m/), sharp subboundaries develop during deformation; dynamic recrystallization corresponds to discontinuous subgrain growth, perhaps as a result of fluctuations in the dynamic balance at steady state.

26383 **Thorium segregation to grain boundaries in Ir + 0.3% W alloys containing 5-1000 ppM thorium.** White, C.L.; Heatherly, L.; Padgett, R.A. (Oak Ridge National Lab., TN). *Acta Metallurgica;* **31**: 111-119(1983). Contract W-7405-ENG-26.

Thorium additions to Ir + 0.3% W alloys are known to greatly increase their ductility during high temperature impact (HTI). Segregation of thorium to grain boundaries in alloys containing between 5 and 1000 ppm thorium was studied using Auger electron spectroscopy (AES). High spatial resolution AES was used to analyze thorium rich precipitates on intergranular fracture surfaces of an alloy containing 1000 ppm thorium. Alloys containing as little as 5 ppm thorium were found to have grain boundary Th/Ir atomic ratios of ~0.1 after a 1 h, 1500°C vacuum anneal. The thorium enriched region was only a few atom layers thick, however. No additional increase in grain boundary thorium level was observed as the overall thorium level was increased from 5 to 1000 ppm. This result indicates a solubility limit of thorium in Ir + 0.3% W of ≦5 ppm. It also indicates that significant improvements in the HTI ductility of Ir + 0.3% W should be possible with thorium additions as low as 5 ppm. Preliminary HTI results are presented that support this position.

26384 **Role of geometry in plastic instability and fracture of tubes and sheet.** Stout, M.G.; Hecker, S.S. (Los Alamos National Lab., NM). *Mechanics of Materials;* **2**: 23-31(1983).

Conditions for plastic instability and fracture for biaxially loaded tubes are compared to those for a sheet to assess the role of geometry. Thin-walled tubes of 70-30 brass were loaded in combined axial tension-internal pressure. The strains for diffuse instability, local instability and fracture were measured and compared to results on brass sheet. Uniform deformation (up to diffuse instability) was found to be very sensitive to geometry in agreement with theory. The uniform strain in tubes for axial plane strain is twice that for hoop plane strain and the uniform strain in tubes for balanced biaxial tension is only one third of that for sheet. The strain levels for local instability and fracture did not depend on geometry. No significant differences were found for axial vs. hoop loading in tubes and the critical strain levels for tubes were actually somewhat greater than those for sheet. Although the critical local strains are similar, the amount of useful (general) deformation beyond diffuse instability for tubes is very limited because localization occurs rapidly. In bulged or punched sheet the geometry is stable and localization occurs gradually, providing significant post-uniform deformation.

26385 **Fracture strains in biaxially loaded 2024 aluminum tubes.** Stout, M.G.; Hecker, S.S. (Los Alamos National Lab., NM). *Mechanics of Materials;* **2**: 19-22(1983).

2024 aluminum tubes, heat treated to a T6 and T8 temper, were proportionally loaded to failure with combinations of tension and internal pressure. Diffuse instability and fracture strains were measured and compared to the ductile fracture model of Ghosh (1976). Fracture strains measured in axial tension and pure hoop tension were equivalent even though anisotropies were observed in the plastic deformation of the tubes.

26386 **Theory of scattering of elastic waves from flat cracks of arbitrary shape.** Visscher, W.M. (Los Alamos National Lab., NM). *Wave Motion;* **5**: 15-32(1983).

A method, based on a boundary-integral representation of the elastic displacement, for calculating crack-opening-displacements on a flat crack of arbitrary shape and for incident elastic waves of arbitrary direction, polarization, and wavelength is developed and illustrated by application to Rayleigh scattering from two families of crack shapes. The crack-opening-displacement is expanded in a truncated complete set of functions on the crack surface. This transforms the boundary-integral representation into a matrix equation with rank three times the order of the truncation. This matrix equation has the properties that it can be expressed as the result of an extremum principle with respect to variations of the expansion coefficients of the crack-opening-displacement (thus converges as the truncation order increases) and the matrix kernel (which must be inverted) is positive definite. A conclusion drawn is that only very accurate experiments can distinguish a flat crack of general shape from a penny-shaped crack by long-wavelength elastic-wave scattering.

26387 **Work function-chemisorption study of hydrogen on iron: kinetics and strain effects.** Pasco, R.W.; Ficalora, P.J. (Syracuse Univ., NY). *Acta Metallurgica;* **31**: No. 4, 541-558(1983).

Work function (surface potential) changes occurring upon adsorption of hydrogen on iron have been measured by the static capacitor method. The effect of applying strain to the iron foil while in equilibrium with the hydrogen ambient has also been determined. The kinetics of dissociative adsorption have been shown to be consistent with control by the surface migration of the adsorbed hydrogen molecule. It has also been shown that straining the iron foil into the plastic region decreases the equilibrium surface concentration of atomic hydrogen, the embrittling species, postulated to occur through the surface migration of atomic hydrogen to strain produced "catalytically active" recombination defect sites on the surface. These results are shown to be consistent with observed crack growth kinetics. The effects of pressure, temperature and material strength on Stage II (slow) crack growth kinetics are easily explained with a kinetic model based upon adsorption/desorption kinetics and the experimentally determined effect of plastic strain.

26388 **Relation between the heats of mixing of the liquid and solid in metallic systems.** Williams, R.O. (Oak Ridge National Lab., TN). *CALPHAD: Computer Coupling of Phase Diagrams and Thermochemistry;* **7**: No. 1, 21-26(1983). Contract W-7405-ENG-26.

The average heat of mixing for binary liquid metal alloys is 1.05 k J/mol more negative than that of the solid solution. This result applies for systems that have very negative heats of mixing to those with very positive values. Real systems show a standard deviation of 1.25 k J/mol from this model. It is clear that those factors which are responsible for the heats of mixing having a certain value in a given solid solution operate similarly in the liquid. In particular, size differences do not appear to be an important factor in determining the heats of mixing.

26389 **Metallurgical investigation of a gray cast iron 16-in.-diam water line failure at Oak Ridge National Laboratory.** Gray, R.J.; Houck, C.W.; Hobson, D.O. (Oak Ridge National Lab., TN). *Microstructural Science;* **11**: 351-370(1983). Contract W-7405-ENG-26.

More than 95% of the distribution water mains in the United States are cast iron. Some mains have remained in service for 100 to 125 years. Some subterranean cast iron pipes that were installed in Versailles, France in 1664 were reported to still be in service in the middle of this century and may be functioning today. An investigation of a break in a 16-in.-diam, 4.46-m (14.6 ft) long, potable water main at Oak Ridge National Laboratory on October 8, 1981 is discussed. The 16-in.-diam line had been installed in the mid-1940's following conventional industrial piping practices of the time and nearly all of that line still remains in use. During the 1960 and 1970 period, the failed section of the water line received extensive direct modification and the ground support has been disturbed in this location in the installation of other piping. However, these more recent modifications had received closer monitoring and quality control than the original installation. The location of this ruptured section of the water main was immediately south of the Holifield Heavy Ion Research Facility at ORNL and the 1 million gallons of water that were released caused flooding in the ground floor of this building. This report is organized into several sections - a metallographic section containing both macro- and micrographic views of the pipe structure, a short overview of the corrosion and fracture toughness studies, results and discussion, and conclusions.

26390 **Structural characteristics of cobalt particles in a 9.5% Co-ZSM-5 catalyst.** Dhere, A.G.; De Angelis, R.J.; Reucroft, P.J.; Bentley, J. (Univ. of Kentucky, Lexington). *Journal of Molecular Catalysis;* **20**: 301-309(1983). Contract AC22-81PC41760;AS05-82ER12098.

A detailed structural study of cobalt particles in a 9.5%Co-ZSM-5 catalyst was made using X-ray diffraction and analytical transmission electron microscopy. The results obtained from these two techniques show that the cobalt particles contain a high concentration of basal plane stacking faults. On the average one out of every 12 basal planes is faulted. It is suggested that atoms of a par-

ticle which lie at positions on the surface where intersection stacking faults exist may be the origin of active sites.

26391 Residual stress determination in Inconel-600. Srinivasan, R. (SUNY-Stony Brook, NY); Hartley, C.S.; Bandy, R. pp 163-174 of Novel techniques in metal deformation testing. Wagoner, R.H. (ed.). St. Louis, MO; Metallurgical Society of AIME (1983).

From Fall meeting of the Metallurgical Society of AIME; St. Louis, MO, USA (25-26 Oct 1982).

Electrochemical machining (ECM) provides a rapid, easily controlled and damage free method of metal removal. Utilization of this technique to reduce the cross-sectional area of a tube offers an accurate procedure for obtaining data to calculate the residual stress distribution using the Sachs technique. Results of such a study conducted on cold-drawn Inconel 600 tubes in the as-received and annealed condition indicate that ECM avoids many problems, associated with methods based on mechanical removal of material, which may lead to alteration of the internal stress state during the measurement. Principal stresses in as-received material cause the tube to be in or near the plastic state throughout 85% of the tube wall thickness. Annealing for two hours at 1200 K followed by air cooling reduces the principal stresses substantially.

26392 Study of positron lifetimes in α, β, and γ cerium at high pressures. Boring, A.M. (Los Alamos National Lab., NM); Huang, C.Y.; Gschneidner, K.A. Jr.; McGervey, J.D.; Panigrahi, M.; Usmar, S.G. *Journal of Magnetism and Magnetic Materials;* **37**: L7-L10(1983).

The positron lifetimes in the α, β, and γ phases of Ce have been measured by applying hydrostatic pressure (up to 1.4 GPa) and by reducing the temperature (to 80 K). Two-component fitting programs showed that the main component ($\approx$90%) had virtually the same mean lifetime ($\approx$233 ps) in all three phases. The uncertainty in each lifetime was +/- 2 ps. With this high precision, the results are in agreement with those of band calculations which give the same number of 4f electrons ($\approx$1.2) in all phases.

26393 Thermal conductivity, electrical resistivity, and Seebeck coefficienct of SRM-735. Graves, R.S.; Williams, R.K.; Moore, J.P. (Oak Ridge National Lab., TN). pp 343-349 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract W-7405-ENG-26.

The thermal conductivity of an austenitic stainless steel standard (SRM-735) was measured in two apparatus over the combined temperature range form 2 K to 970 K and found to be within the uncertainty band claimed by the NBS above 60 K. The results were in error by as much as 4% below 60 K because of limited sensitivity of the detection instrument and low sensitivity of the thermocouples. The electrical resistivity results were within the uncertainty claimed for the standard.

26394 Transport properties of concentrated Ag-Pd and Cu-Ni alloys from 300-1000 K. Yarbrough, D.W.; Williams, R.K.; Graves, R.S. (Oak Ridge National Lab., TN). pp 319-324 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract W-7405-ENG-26.

For temperatures above 300 K, thermal conductivity data for concentrated binary silver-palladium and copper-nickel alloys are scarce. A recent review and analysis of thermal conductivity data for selected binary alloy systems included extrapolations of existing data for Ag-Pd and Cu-Ni into composition and temperature regions where data were absent. Over a broad composition range, the electronic Lorenz functions that were calculated showed high temperature values significantly below the Sommerfeld value, $L_o = 2.443 \times 10^{-8} V^2K^{-2}$. These results strongly suggested the collection of additional experimental data to confirm the published extrapolation. Values for thermal conductivity, electrical resistivity, and absolute Seebeck coefficient, were measured for the alloys silver (50 wt %)-palladium (50 wt %) and copper (50 wt %)-nickel (50 wt %) in the temperature interval 300-1000 K. Results for the three transport properties presented show that the electronic Lorenz functions exceed the Sommerfeld value over most of the temperature range studied.

26395 Thermal conductivity and Lorenz number of plutonium and plutonium-gallium alloys. Andrew, J.F. (Los Alamos National Lab., NM); Klemens, P.G. pp 209-218 of Thermal conductivity 17. Hust, J.G. (ed.). New York, NY; Plenum Publishing Corp. (1983).

The thermal diffusivities of Pu, Pu-2.7 at.% Ga, Pu-3.5 at.% Ga, and Pu-6.6 at.% Ga were measured from 25°C to around 500°C using a laser flash technique and electronic data acquisition. Although the Lorenz number, L, of pure Pu is well below the Sommerfeld value, L_o, except for the α-phase, L exceeds L_o for the alloys at all temperatures and has a pronounced minimum around 200°C. At the lower temperatures the excess is attributed to lattice conduction and at temperatures above 200°C the excess is attributed to an electronic component. The negative deviation of L from L_o for pure Pu is ascribed to a reduction of the electron mobilities in those energy ranges where the 5f bands overlap the conduction bands.

26396 Physical properties of 9 Cr-1 Mo steel from 300 to 1000 K. Williams, R.K.; Graves, R.S.; Weaver, F.J.; McElroy, D.L. (Oak Ridge National Lab., TN). pp 219-228 of Thermal conductivity 17. Hust, J.G. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract W-7405-ENG-26.

The thermal conductivity and expansion of an improved 9 Cr-1 Mo steel were studied. The results show that the electron and phonon thermal conductivity components are both quite sensitive to Si content. The thermal expansion of standard commercial material is indistinguishable from that of the improved alloy.

26397 Physical properties of V(Fe, Co, Ni)$_3$ alloys from 300 to 1000 K. McElroy, D.L.; Williams, R.K.; Weaver, F.J.; Graves, R.S. (Oak Ridge National Lab., TN). pp 337-341 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract W-7405-ENG-26.

The temperature dependence of the transport properties, i.e., thermal conductivity, electrical resistivity, and thermopower and the thermal expansion coefficients were determined in the range 300 to 1000 K for three alloys: water quenched V(Fe/sub 0.22/Co/sub 0.78/)$_3$, ordered V(Fe/sub 0.22/Co/sub 0.78/)$_3$ and ordered V(Fe/sub 0.6/Ni/sub/0.4/)$_3$, modified with Ti. These long-range-ordered alloys have superior structural performance at elevated temperatures and one goal of this study was to assess the resistance of these experimental alloys to thermal stresses in advanced power system applications. Cylindrical specimens, 1 cm diam by 7.8 cm long, were machined from ingots arc-melted in helium and were heat treated as indicated below to produce samples for physical property measurements. Data obtained during several thermal cycles were least squares fitted with linear or quadratic equations to obtain the smoothed property values.

26398 Ion damage in 316 stainless steel over a broad dose range. Packan, N.H.; Farrell, K. (Oak Ridge National Lab., TN). pp 885-894 of Effects of radiation on materials. Brager, H.R.; Perrin, J.S. (eds.). Philadelphia, PA; American Society for Testing and Materials (1983). Contract W-7405-ENG-26.

Microstructural evolution was examined in annealed 316 stainless steel after heavy-ion bombardment in the range 1 to 256 dpa at 900 K with simultaneously implanted helium at a rate of 10 appm/dpa and deuterium at a rate of 25 appm/dpa. Phase decomposition was rather limited compared with that in neutron irradiations; only an unidentified plate-like precipitate at low dose, and blocky $M_{23}C_6$ particles on grain boundaries were formed. Swelling from cavity formation increased with dose to about 20% at about 200 dpa above which it appeared to saturate. Cavity concentrations saturated at about 100 dpa, and dislocations much earlier. The matrix cavities included a persistant complement of ~7-nm diam small cavities. Similar-size helium bubbles were prolific on the grain boundaries.

26399 Microstructure and tensile properties of neutron-irradiated (Fe/sub 0.61/Ni/sub 0.39)$_3$V ordered alloy. Braski, D.N. (Oak Ridge National Lab., TN). pp 325-340 of Effects of radiation of materials. Brager, H.R.; Perrin, J.S. (eds.). Philadelphia, PA; American Society for Testing and Materials (1983). Contract W-7405-ENG-26.

Small tensile specimens of (Fe/sub 0.61/Ni/sub 0.39/)$_3$V long-range-ordered alloy were irradiated in the ORR to 4 dpa at 523, 623, and 823 K and subsequently tested at the same respective temperatures. The alloy remained ordered after irradiation at all three temperatures. Irradiation at 523 and 623 K increased the yield strength of the material by producing Frank loops in the microstructure and reduced the total elongation. The low strain hardening observed was attributed to planar slip. Irradiation at 823 K embrittled the alloy. Premature failure was apparently initiated by helium bubbles on sigma phase boundaries which grew rapidly during the test to form microcracks. Fracture occurred after a microcrack propagated across grain boundaries that were weakened by helium and possibly sulfur. Modifying the composition of LRO alloys to eliminate sigma phase should lead to improved performance under neutron irradiation.

26400 Comparison of neutron and heavy-ion damage in a single-phase austenite. Farrell, K.; Packan, N.H. (Oak Ridge National Lab., TN). pp 953-962 of Effects of radiation of materials. Brager, H.R.; Perrin, J.S. (eds.). Philadelphia, PA; American Society for Testing and Materials (1983). Contract W-7405-ENG-26.

Damage microstructures are compared at a dose of 10 dpa in a high-purity Fe-Ni-Cr-Mo alloy after irradiation in EBR-II and after nickel ion bombardment at temperatures encompassing the peak swelling. The damage features are qualitatively similar, but there are less cavities in the ion bombarded specimens. Incorporation of helium during the ion bombardments improves but does not eliminate this discrepancy. The level of peak swelling is 1/3 that for the neutron irradiations. The upward shift in peak swelling temperature with four orders of magnitude increase in damage rate is 75 K when helium is absent during ion bombardment, and 125 K when helium is coimplanted. These effects are consistent with theoretical predictions. It is concluded that ion bombardments can match a required level of neutron swelling when the appropriate, empirical temperature shift and dose equivalency are applied, but such translations may not adequately reproduce the quantitative microstructural aspects.

26401 Magnetic form factors. Moon, R.M. (Oak Ridge National Lab., TN). *Journal de Physique (Paris), Supplement;* **43**: No. 12, 187-197(Dec 1982). Contract W-7405-ENG-26.

Polarized neutron diffraction has been an extremely valuable technique for studying outer electron distributions in magnetic materials through measurements of magnetic form factors. Representative results are presented on the following classes of elemental materials: 3d ferromagnetic metals, paramagnetic metals, rare-earth metals, and diamagnetic materials. In each case a comparison with the best available theoretical result is given. It is concluded that more theoretical effort is needed on the orbital moment in transition metals, particularly for the paramagnetic metals, in order to have a meaningful confrontation between theory and experiment.

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REFER ALSO TO CITATION(S) 25942, 26334, 26352, 26354, 26355, 26359

26402 (AD-A—136798/6) Role of Al2O3 in sintering of submicron yttria-stabilized ZrO2 powders. Technical report No. 8 (final) Oct 80-30 Sep 83. Buchanan, R.C.; Wilson, D.M. (Illinois Univ., Urbana (USA). Dept. of Ceramic Engineering). 2 Dec 1983. 39p. NTIS, PC A03/MF A01.

The use of A12O3 (up to approximately 3.5 wt%) as a sintering aid to promote rapid densification of precipitated yttria (8.0 wt. %) stabilized Zirconia (YSZ) powders in the range 1100 - 1350 C, was investigated. The A12O3 was added as hydrated A1(OH) and dispersed by milling in a 60 : 40 alcohol : water solution, followed by pressing at 205 MPa. Significantly increased densification was obtained with A12O3, even below 1200 C, and optimum densification (>99.0% Th.D.) occured at 1350 C/1 hr. with 0.325 wt% A12O3. These samples exhibited enhanced electrical conductivity and larger grain size (0.3 - 0.5 micrometer). TEM microstructural observations and densification kinetic data indicated a liquid phase assisted sintering mechanism. Solid state doping of the ZrO2 by A1 was inferred from the electrical conductivity data.

26403 (AD-A—137513/8) Compressive strength and damage mechanisms in partially stabilized zirconia. Interim technical report 1 Aug 82-31 Dec 83. Lankford, J.; Sherman, R. (Southwest Research Inst., San Antonio, TX (USA)). Dec 1983. 52p. (SWRI—06-4231). NTIS, PC A04/MF A01.

The flow and fracture behavior of partially (Mg) stabilized zirconia subject to compressive loading was characterized for a wide range of strain rates and temperatures. It was found that the material exhibits plastic flow from 23C to 1200C, and that the flow stress curve is serrated. Contrary to results for A1203, SiC, and Si3N4, the strain rate dependence of compressive strength for PSZ does not correlate with the stress intensity dependence of subcritical crack growth velocity. These results, combined with the presence of an unusual type of deformation banding, have been interpreted in terms of plastic strain-induced, co-operative martensitic transformation of metastable precipitates. Additional work has performed as part of an effort to establish the role of grain boundaries and grain boundary chemistry in the deformation and fracture of PSZ. Initial work has involved Auger electron spectroscopy of Ca-stabilized PSZ. It was found that intergranular regions are enriched in silica and calcium, and that grain boundary facets were apparently coated by a thin, continuous second phase film.

26404 (CONF-840664—5) Cation self-diffusion in Fe_2O_3. Hoshino, K.; Peterson, N.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009152.

From 9. international congress on metallic corrosion; Toronto, Canada (3 Jun 1984).

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Self-diffusion of ^{59}Fe in single crystals of Fe_2O_3 parallel to the c-axis has been measured as a function of temperature (1150 to 1340°C) and oxygen partial pressure (2×10^{-3}) $\leqq P_{O_2} \leqq$ 1 atm). The oxygen partial pressure dependence of the diffusivity indicates that cation self-diffusion occurs by an interstitial-type mechanism. The simultaneous diffusion of ^{52}Fe and ^{59}Fe has been measured in Fe_2O_3 at 1251°C and $P_{O_2} = 1.91 \times 10^{-2}$ atm. The small value of the isotope effect ($f\Delta K = 0.067 +- 0.016$) is consistent with diffusion of Fe ions by an interstitially mechanism.

26405 (DOE/ER/10708—T1) Investigation of the role of sintering in gas-solid interactions. Progress report. Munir, Z.A. (California Univ., Davis (USA). Dept. of Mechanical Engineering). May 1983. Contract AT03-80ER10708. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010862.

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The following research has been done: an investigation of the influence of the decomposition of a precursor [$Cd(OH)_2$] on the particle size of a ceramic product (CdO), and the influence of sintering on the reduction of iron oxides. (DLC)

26406 (EGG-SCM—6572) Joining silicon nitride based ceramics: a technical assessment. Tallman, R.L.; Neilson, R.M. Jr.; Mittl, J.C.; Henslee, S.P.; Kelsey, P.V. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011356.

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This technical assessment provides information on ceramic joining and on oxynitride glasses as a basis for work on joining silicon nitride. The conclusions and recommendations are general in nature. 141 references.

26407 (LBL—17369) High resolution electron microscopy studies of the early stages of decomposition in alloys and ceramics. Gronsky, R.; van Tendeloo, G.; Thomas, G. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 19p. (CONF-8309229—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010802.

From Acta/Scripta conference; Sonnenberg, F.R. Germany (19 Sep 1983).

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In this paper, some applications of high resolution electron microscopy to studies of the early stages of decomposition in alloys and ceramics is described. Two important parameters of the decomposition process, structural evolution and compositional variation, are specifically addressed. Since these applications push the limits of both image formation and computer simulation, a number of critical technique-related problems are identified.

26408 (ORNL/TM—9042) Chemical vapor deposition of erosion-resistant TiB_2 coatings. Caputo, A.J.; Lackey, W.J.; Wright, I.G. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010640.

Erosion- and wear-resistant coatings are needed for numerous applications, including valve and pump components for coal liquefaction and gasification plants. Titanium diboride is unusually hard and stable and offers considerable promise for use in highly erosive and corrosive environments. We deposited TiB_2 coatings by hydrogen reduction of $TiCl_4$ and BCl_3. Our objective was to correlate process variables with coating structure and properties, with emphasis on obtaining coatings having high erosion resistance. We varied deposition temperatures from 750 to 1050°C and the $TiCl_4$ and BCl_3 flow rates. Commercial cemented carbides and experimental nickel-bonded TiB_2 were used as substrates. After structural characterization, the resistance of the deposited coatings to erosion was determined by a hot coal-oil slurry impingement test. The deposition rate was very temperature dependent, ranging from 0.1 to 2.9 μm/min between 750 and 950°C. The surface of the coatings showed nodules increasing in size with temperature. The coatings were dense and adherent. The grain size varied with deposition conditions. Often, the grains were too small to resolve optically, but transmission electron microscopy showed the grain size to be very small (2 to 300 nm) and to increase with distance from the substrate. Electron microscopy and x-ray diffraction showed only single-phase TiB_2, and ion microprobe analysis revealed a constant Ti:B ratio across the coating thickness. Energy-dispersive fluorescence analyses showed more chlorine in coatings deposited at 800°C than in coatings deposited at higher temperatures. The Knoop hardnesses of coatings deposited at 800 and 900°C were 15 and 33 GPa, respectively. Coatings deposited at 850°C or below eroded extensively (up to 30-μm-deep craters during a 1-h test), while those deposited at 900°C and above showed very little or no erosion (0 to 2 μm). 10 references, 11 figures, 3 tables.

26409 (SAND—84-0454C) Precursor chemistry effects on development of particulate morphology during evaporative decomposition of solutions. Gardner, T.J.; Sproson, D.W.; Messing, G.L. (Sandia National Labs., Albuquerque, NM (USA); Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). 1984. Contract AC04-76DP00789. 15p. (CONF-840258—7). NTIS, PC A02; 3; GPO Dep. Order Number DE84008987.

From Materials Research Society spring meeting; Albuquerque, NM, USA (27 Feb 1984).

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Fine-grained, high surface area MgO, NiO and ZnO powders were synthesized by the evaporative decomposition of solutions (EDS) technique at 1000°C from acetate and nitrate salt solutions. The powder characteristics were similar in all cases; however, aggregated powders were obtained from the nitrate salts and aggregate-free powders were obtained from the acetate solutions when reacted in air. This difference is attributed to the oxidation of the acetate radical and/or its residue and that this process acts to disaggregate the salt droplet/particles that are formed during EDS.

26410 Moessbauer and magnetic studies of ε-Fe/sub x/N, $2<x<3$. Chen, G.M.; Jaggi, N.K.; Butt, J.B.; Yeh, E.B.; Schwartz, L.H. (Northwestern Univ., Evanston, IL). *Journal of Physical Chemistry;* **87**: No. 26, 5326-5332(22 Dec 1983). Contract AC02-78ER04993.

The magnetization and Moessbauer spectra of ε-Fe/sub x/N, $2<x<3$, have been measured from 4.2 to 300 K. The results reveal that the earlier models of structure and magnetism in this system are insufficient to explain the rapid decrease of magnetization and Curie temperature in the vicinity of $x = 2$. The Moessbauer data exhibit independent evidence of deviation both from the accepted ordering scheme for N atoms and from the linear decrease of magnetic moment with number of N atoms in the nn shell predicted by the near-neighbor donor model. A dependence of the iron moment on the composition of the second nn shell is suggested by the Moessbauer spectra. A combined analysis of magnetization and Moessbauer data rules out spin-glass-like behavior, which may be suspected from the anomalies observed in the temperature dependence of the magnetization measured in a field of 0.5 kOe. 7 figures, 2 tables.

26411 Growing single crystals of refractory materials. Boatner, L. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 120-127(Fal 1983).

Man-made single crystals are commonly used for electronic devices, lasers, gemstones, and structural materials. The Oak Ridge National Laboratory's program to grow crystals from hard-to-melt materials for possible use in systems to produce energy, transmit electricity, store nuclear wastes, and process optical signals is described. The future direction of ORNL's research on single crystals of refractory substances is discussed.

26412 Advanced structural ceramics. Becher, P.F. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 96-101(Fal 1983).

Ceramics are very hard materials and can be quite strong at high temperatures but because they are brittle, they have had only limited use in energy conversion devices. ORNL's research staff has found that incorporating zirconia particles or silicon carbide whiskers into ceramics such as alumina substantially increases the materials toughness, or resistance to cracking under stress. The ORNL research program on improving the properties of ceramics is described.

26413 Enthalpies of thoria-urania from 2300 to 3400 K. Fischer, D.F.; Fink, J.K.; Leibowitz, L. (Argonne National Lab., IL (USA). Chemical Technology Div.); Belle, J. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). *Journal of Nuclear Materials;* **118**: No. 2/3, 342-348(Sep-Oct 1983).

The enthalpies of some thoria-urania solid solutions - (Thsub(0.70)Usub(0.30))O_2, (Thsub(0.85)Usub(0.15))O_2, and (Thsub(0.92)Usub(0.08))O_2 - were measured from 2300 to 3400 K, using an induction-heated drop-calorimeter system. The enthalpy measurements from this work were compared with other reported lower-temperature data, analyzed, and fitted to equations. Discontinuities in the slopes of the enthalpy-temperature curves were found for the various thoria-urania solid solutions at temperatures, Tsub(r), equal to about 0.8 of the melting temperature. This behavior is consistent with that observed for both ThO_2 and UO_2. Heat capacities below the transition temperature, Tsub(r), derived from the enthalpy equations were as predicted from mole averages calculated from ThO_2 and UO_2 data.

26414 Synthesis of refractory materials. Holt, J.B. (to Dept. of Energy). US Patent Application 6-523,556. 16 Aug 1983. 15p. Contract W-7405-ENG-48.

Refractory metal nitrides are synthesized during a self-propagating combustion process utilizing a solid source of nitrogen. For this purpose, a metal azide is employed, preferably NaN_3. The azide is combusted with Mg or Ca, and a metal oxide is selected from Groups III-A, IV-A, III-B, IV-B, or a rare earth metal oxide. The mixture of azide, Ca or Mg and metal oxide is heated to the mixture's ignition temperature. At that temperature the mixture is

ignited and undergoes self-sustaining combustion until the starter materials are exhausted, producing the metal nitride.

26415 **Hard metal composition.** Sheinberg, H. (to Dept. of Energy). US Patent Application 6-517,536. 26 Jul 1983. 10p. Contract W-7405-ENG-36.

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A composition of matter having a Rockwell A hardness of at least 85 is formed from a precursor mixture comprising between 3 and 10 wt % boron carbide and the remainder a metal mixture comprising from 70 to 90% tungsten or molybdenum, with the remainder of the metal mixture comprising nickel and iron or a mixture thereof. The composition has a relatively low density of between 7 and 14 g/cc. The precursor is preferably hot pressed to yield a composition having greater than 100% of theoretical density.

26416 **High surface area ThO_2 catalyst.** Colmenares, C.A.; Somorjai, G.A.; Maj, J.J. (to Dept. of Energy). US Patent Application 6-506,559. 21 Jun 1983. 13p. Contract W-7405-ENG-48.

A ThO_2 catalyst having a high surface area of about 80 to 125m^2/g is synthesized. The compound is synthesized by simultaneously mixing an aqueous solution of $ThNO_3(NO_3)_4.4H_2O$ with an aqueous solution of $Na_2CO_3.H_2O$, to produce a solution and solid $ThOCO_3$. The solid $ThOCO_3$ is separated from the solution, and then calcined at a temperature of about 225 to 300°C for about 40 to 55 hours to produce ThO_2. The ThO_2 catalyst produced includes Na present as a substitutional cation in an amount equal to about 5 to 10 at. %.

26417 **Effect of indenter geometry on controlled-surface-flaw fracture thoughness.** Petrovic, J.J. (Los Alamos National Lab., NM). *Journal of the American Ceramic Society;* **66**: No. 4, 277-283(Apr 1983).

Fracture toughness values obtained using both Knoop and Vickers-indentation-produced controlled surface flaws were compared as a function of indentation load for a well-characterized glass-ceramic material. At the same indentation load, Knoop cracks were larger than Vickers. As-indented K/sub c/ values calculated from fracture mechanics expressions for surface flaws were higher for Knoop flaws than Vickers, but both types gave low K/sub c/ values due to indentation residual stress effects. Analysis suggested that theoretical formalisms for indentation residual stress effects based on fracture mechanics solutions for a center-loaded penny crack in an infinite medium should apply to both indentation types. K/sub c/ values calculated using the residual stress approach were identical for Knoop and Vickers controlled surface flaws when a "calibration" value for a constant term in the expression for K/sub c/ was used for both indentation types.

26418 **Analytical and experimental evaluation of biaxial contact stress.** Richerson, D.W.; Finger, D.G.; Wimmer, J.M. (Garrett Turbine Engine Co., A Division of the Garrett Corp., 111 South 34th St., Phoenix, AZ 85010). pp 163-184 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—).

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter examines contact stress analysis for ceramic-metal and ceramic-ceramic interfaces utilizing finite element analysis. Discusses biaxial contact loading; room temperature contact testing; high temperature contact testing; contact surface examination; friction versus temperature and normal load; and retained strength and calculated tensile stress. Finds that the results correlated closely with closed-form solutions both for normal and normal-tangential loading. Points out that the presence of a high tensile stress spike at the surface of a ceramic under sliding or biaxial contact loading has important implications and may explain the cause of failure or surface damage in many applications. Experimental data obtained for room temperature conditions agreed well both with finite element and closed-form solutions. Concludes that the high temperature contact test results have implications on design of ceramics for high temperature structures such as heat engine components.

26419 **Thermal stress fracture of ceramic coatings: Measurements, transformations, and high-temperature fracture.** Andersson, C.A. (Westinghouse Research and Development Center, Pittsburgh, PA 15235). pp 497-509 of Fracture mechanics of ceramics. Bradt, R.C.; Evans, A.G.; Hasselman, D.P.H.; Lange, F.F. New York, NY; Plenum Publishing Corp. (1983). (CONF-810746—).

From International symposium on the fracture mechanics of ceramics; University Park, PA, USA (15 Jul 1981).

This chapter examines thermal stress failures of ceramic coatings in terms of fracture mechanics concepts. Considers the effects of transient and residual stresses on single and multiple cycle failure mechanisms. Presents a specific example of a zirconia thermal barrier coating and calculates its endurance using the proposed relationship. Investigates the resistance of coatings to spallation and flaking due to thermal cycling. Discusses coating stresses and cracks; stress intensity factors; cyclic thermal stress failure; property measurements; fracture strength of the bond; fracture toughness; cyclic subcritical crack growth rates; coating properties; and coating endurance. Concludes that fracture mechanics provides the best approach to determining thermal stress failures of coatings since both single and multiple cycle failures can be taken into account.

26420 **Microchemistry and microstructure of a multiphase aluminosilicate ceramic.** Risbud, S.H.; Zangvil, A. (Univ. of Illinois, Urbana). *Journal of Materials Science;* **18**: 998-1004(1983). Contract AC02-76ER01198.

The microstructure and microchemistry of a sintered (≈ 1700°C) aluminosilicate ceramic (60 wt% Al_2O_3 - 40 wt% SiO_2) was investigated by optical, scanning (SEM and EDAX), and analytical electron microscopy (TEM and STEM). The microstructural features of the fired ceramic consisted of unreacted Al_2O_3, glass, porosity, and equilibrium and metastable mullite phases. Residual Al_2O_3 agglomerates (≈ 15 to 30μm in size) were surrounded by a ≈6μm layer of equilibrium mullite (≈ 71.3 to 73.5 wt% Al_2O_3). The unreacted Al_2O_3-equilibrium mullite assembly formed islands embedded in a silica rich glass (≈4.5 to 14 wt% Al_2O_3) which also contained 2 to 3 μm thick metastable mullite needles (≈70 to 77 wt% Al_2O_3). Phase separation and alumina rich glass compositions (≈ 57 to 59 wt% Al_2O_3) were also observed in some areas of the microstructure. 7 references, 8 figures, 1 table.

26421 **Grain boundary microstructures in a liquid-phase sintered alumina (α-Al_2O_3).** Hansen, S.C.; Phillips, D.S. (Univ. of Illinois, Urbana). *Philosophical Magazine;* **47**: No. 2, 209-234(1983). Contract AC02-76ER01198.

Grain boundary microstructures in a commercial 99.8% alumina ceramic were analyzed using transmission electron microscopy. Nearly all boundaries were wet by an amorphous film which should invalidate both the CSL and DSC lattice constructions. Facets of widely differing sizes were observed primarily on basal (0001), rhombohedral (1012), and prism (1120) planes. The facets were always multi-atomic in height and range up to ~1000 Angstroms; this probably results from substantial anisotropy in the Al_2O_3-glass interfacial energy. Basal annealing twins were observed without amorphous films; they lie predominantly on (1120) and show interfacial energies much lower than adjacent random boundaries.

26422 **Ex-reactor determination of thermal gap conductance between uranium dioxide: Zircaloy-4 interfaces.** Garnier, J.E. (Pacific Northwest Lab., Richland, WA); Begej, S.; Desjarlais, A.O.; Tye, R.P. pp 211-219 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corp. (1983).

An ex-reactor study was undertaken to determine the thermal gap conductance between UO_2 and Zircaloy-4. Both a transient technique (Modified Pulse Design) and a steady state technique (Modified Longitudinal Design) were used. The experimental variables were the mean-plane gap (2.7-135.0 μm), gas composition (He, Ar, He:Ar mixture, He:Xe mixtures), surface roughness, and temperature (293-893 K). The pressure was held constant at one atmosphere. The results were compared with gap conductance calculations utilizing three temperature jump distance models, and it was concluded that the GAPCON-THERMAL II model fits the data

best. Considerable scatter was evident and was attributed to a failure to fully account for the three-dimensional aspect of a narrow gap and to a lack of accurate knowledge of the gaseous thermal accommodation coefficients of He, Ar, and Xe on UO_2 and Zr-4 surfaces.

3603 Composite Materials

REFER ALSO TO CITATION(S) 26681, 26699, 26700, 27620

26423 **Electropositive bivalent metallic ion unsaturated polyester complexed polymer concrete.** Sugama, T.; Kukacka, L.E.; Horn, W.H. (to Dept. of Energy). US Patent Application 6-494,484. 13 May 1983. 23p. Contract AC02-76CH00016.

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Quick setting polymer concrete compositions are described which are mixtures of unsaturated polyesters and crosslinking monomers together with appropriate initiators and promoters in association with aggregate which may be wet and a source of bivalent metallic ions which will set to polymer concrete with excellent structural properties.

26424 **Low temperature thermal conductivities of glassy carbons.** Anderson, A.C. (Univ. of Illinois, Urbana). pp 133-138 of Thermal conductivity 16. Larsen, D.C. (ed.). New York, NY; Plenum Publishing Corp. (1983). Contract AC02-76ER01198.

Glassy carbon is a dense, black material with the appearance and mechanical properties of a glass. Glassy carbons are used commercially for such diverse applications as sample supports in high-temperature furnaces and as electrical heaters in hair blow-dryers. The author has been interested in glassy carbons for two reasons, first, to determine if glassy carbons exhibit the low-temperature properties which are characteristic of amorphous materials and, second, to determine if glassy carbons would be suitable as a construction material in cryogenic apparatus. Two very different geometrical forms of glassy carbons were investigated. One was in the shape of a simple rod of 0.3 cm diameter. The other was a reticulated structure, i.e., a rigid, low density material comprised of interconnected carbon filaments. An individual filament had a diameter of roughly 0.01 cm. For either structure, the glassy carbon product was formed through the 1000°C or 2500°C pyrolysis of highly cross-linked polymeric materials. The thermal transport properties of glassy carbons are discussed.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 25453, 26486, 26544, 26700

26425 **(BNL-NUREG—34425) Evaluation of the radiation resistance of high-density polyethylene.** Dougherty, D.R.; Adams, J.W.; Barletta, R.R. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 8p. (CONF-840307—30). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010515.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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Mechanical tests following gamma irradiation and creep tests during irradiation have been conducted on high-density polyethylene (HDPE) to provide data to help assess the adequacy of this material for use in high integrity containers (HICs). Two types of HDPE, a highly cross-linked rotationally molded material and a non-cross-linked blow molded material, were used in these tests. Gamma-ray irradiations were performed at several dose rates in environments of air, Barnwell and Hanford backfill soils, and ion-exchange resins. The results of tensile and bend tests on these materials following irradiation are presented along with results on creep during irradiation. 8 references, 9 figures, 2 tables.

26426 (DL/SCI/R—19, pp 72-77) **Use of synchrotron radiation for study of structural changes in polymers.** Forgacs, P. (Research Inst. for Plastics, Budapest (Hungary)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The use of high intensity synchrotron radiation and position-sensitive counters make it possible to carry out short-time wide-angle x-ray scattering experiments for investigation of structural changes accompanying macroscopic processes in polymers. The experimental method developed allow to obtain good spectra in semi-crystalline polymers in a few seconds. Since a large number of exposures can be made in a short time, the method described here proves to be very convenient for x-ray study of melting, premelting and crystallization phenomena.

26427 **(GEPP-TIS—785) Evaluation of polysulfone film as a capacitor dielectric material for neutron generator applications.** Sidnell, N.A. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 30 Apr 1984. Contract AC04-76DP00656. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010765.

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A modified polysulfone film, as manufactured by Bayer (West Germany), is a candidate dielectric material for applications where radiation resistant properties superior to those of Mylar polyester are required. In 1981 it was concluded that polysulfone films exhibited a dielectric strength 20 to 25% lower than Mylar at elevated temperatures of 74°C. Consequently, a new design comparable to the SA2954 Mylar capacitor was formulated with equivalent dielectric strength. This design also demonstrated an improvement in overall reliability as compared to the Mylar design when based on functional electrical test and environmental test performance. This design description and accompanying test results are presented in this report.

26428 **(MLM—3141) Characterization of polyetheretherketone and other engineering thermoplastics.** Whitaker, R.B.; Nease, A.B.; Yelton, R.O. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 13 Apr 1984. Contract AC04-76DP00053. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010668.

Three engineering thermoplastic materials were characterized by thermal/spectroscopic means to assess their suitability in fiberglass-filled molding resins for Mound applications. The three resins examined were: polyetheretherketone (PEEK) from ICI, Ltd., polyetherimide (PEI) from General Electric, and polyethersulfone (PES) from ICI. Thermogravimetric analysis of the three thermoplastics in N_2 showed that all had a decomposition onset temperature $\geq$ 525°C with PEEK > PEI > PES. Melt thermal stability analyses of glass-filled PEEK and of PEI showed <1% weight loss after 2 hr (N_2). Thermomechanical analysis (TMA) of glass-filled PEEK revealed a low temperature (~ 60-70°C) transition below T/sub g/ (~ 150°C). This transition disappeared on subsequent TMA runs and did not reappear on aging at room temperature, which suggests it was the result of molding stresses. Extra transitions below T/sub g/ were also noted for PES and PEI. Direct probe/mass spectroscopy reconstructed ion chromatograms showed water and phenyl sulfone ions to be present in both PES and PEEK (and volatilized below 200°C in vacuum). Water only was observed in PEI. The presence of phenyl sulfone in PEEK was confirmed by FT-IR, and sulfur was found in amounts up to 0.23% by weight in 30% glass-filled molding compounds. A polymerization solvent, such as diphenyl sulfone, is a probable source. Fluoride (from a monomer used in the PEEK polymerization) was also detected in amounts up to 0.17% by weight in the 30% fiberglass molding compounds.

26429 (RL—83-069, pp vp) **Effects of nuclear radiation on the electrical behaviour of polyethylene at 5 K.** Banford, H.M.; Tedford, D.J. (Strathclyde Univ. (UK). Dept. of Electrical Engineering). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

An outline is presented of a proposed investigation into the purely electrical aspects of an irradiated low-temperature polymer with a view to determining the processes which set the criteria for

dielectric failure of the material. Particular emphasis is placed on studies of possible charge trapping.

26430 Small-angle x-ray scattering studies of crazed glassy polymers. Westbrook, P.A.; Fellers, J.F.; Hendricks, R.W.; Lin, J.S. (Univ. of Tennessee, Knoxville). *Journal of Polymer Science, Polymer Physics Edition;* **21**: 969-982(1983).

A small-angle x-ray scattering (SAXS) study of the relaxed craze structure in polystyrene was performed using the Oak Ridge National Laboratory 10-m SAXS facility. Coupled with known results from transmission electron microscopy studies, the SAXS patterns can be interpreted as scattering from an open-cell foam with void spaces interspersed among the fibrils. Results have shown the scattering centers in crazed polystyrene can be modeled as cylinders the axes of symmetry of which are parallel to the tensile axes. Scattering centers are bimodal in their size distribution, with aspect ratios of 1.0 and 2.6. Crazes in lower-molecular-weight polystyrene, while variations in strain rate and test temperature during craze formation have no effect on the relaxed craze morphology. A comparison of SAXS patterns from polystyrene and polycarbonate indicates that the morphologies of their respective crazes are significantly different.

26431 Diamagnetic anisotropy as a probe of electron delocalisation in polymers: application to polydiacetylenes, polyethylene, and polyethylene terepthalate. May, D.L.; Gruner, S.M. (Princeton Univ., NJ). *Journal of Physics C: Solid State Physics;* **15**: L631-L636(1982).

A quartz fiber torsion balance has been used to measure the highly anisotropic diamagnetic susceptibility of a number of polymer materials, including several polydiacetylenes, polyethylene and polyethylene terepthalate. A large diamagnetic anisotropy was observed to be associated with the conjugated backbone of the polydiacetylenes. Using a semiclassical model, the anisotropy is related to an effective electronic delocalization along the polymer backbone. The polydiacetylene, TCDU, exhibited a large change in its anisotropy upon radiation-induced polymerization. The anisotropy of a polyethylene terepthalate film was used to characterize the chain disorder in the sample. These results suggest that diamagnetic anisotropy measurements provide a simple and useful means of probing molecular structure in disordered materials which are difficult to characterize by x-ray diffraction. Specific applications are suggested toward the study of thin film conducting polymers and the polymerization process in plastic films. 24 references, 1 figure.

3606 Other Materials

REFER ALSO TO CITATION(S) 25674, 25676, 25689, 25690, 25691, 25696, 25697, 25795, 25925, 25926, 25926, 25970, 26087, 26219, 26359, 26835, 27239, 27245, 27431

26432 (BNL—34580) Staging transitions in graphite intercalation compounds. McWhan, D.B.; Axe, J.D.; Kim, H.J.; Mertwoy, H.; Koch, T.; Fischer, J.E. (Bell Labs., Murray Hill, NJ (USA); Brookhaven National Lab., Upton, NY (USA); Pennsylvania Univ., Philadelphia (USA). Lab. for Research on the Structure of Matter). Mar 1984. Contract AC02-76CH00016. 7p. (CONF-840140—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010798.

From International symposium on solid state physics under pressure; Izu-Nagaoka, Japan (18 Jan 1984).

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Staging in layer intercalates refers to the formation of ordered periodic sequences of filled and empty gaps between adjacent host layers. Theory and experiment are found to be in good agreement for pressure induced staging transitions in potassium graphite intercalation compounds with compositions KC_8, KC_{24}, and KC_{36}.

26433 (DL/SCI/R—19, pp 28-36) Applications of EXAFS to studies of the structure of amorphous and microcrystalline solids. Gaskell, P.H. (Cambridge Univ. (UK). Cavendish Lab.). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The subject is discussed under the headings: introduction; outline of underlying theory (relationship of EXAFS and elastic scattering techniques; limitations of EXAFS); examples of experimental studies (EXAFS studies of metallic glasses; alkali and alkaline earth cations in amorphous oxides; precipitation in Cu-Al alloys; structure of bimetallic clusters in Pt-Ir catalysts); x-ray absorption near-edge spectra (XANES).

26434 (DL/SCI/R—19, pp 37-43) Refinement of crystal structure using powders. Thompson, P. (Oxford Univ. (UK). Clarendon Lab.). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The following are discussed: reasons for using powder method; two main approaches for dealing with overlapping reflections; (1) careful calibration of a diffractometer with known standards whose peak shape functions are then used to strip an unknown pattern producing a set of structure factors which can be used in the usual manner to refine the structure; (2) method developed by Rietveld, which is a least squares procedure whereby the total diffraction pattern is fitted to a model containing parameters which describe the peak positions (cell constants and instrumental aberrations) parameters which describe the diffraction peak shape and its variation with Bragg angle; X-ray sources; techniques for recording diffraction data. Examples are discussed.

26435 (DL/SCI/R—19, pp 47-53) Application of synchrotron radiation technique to the assessment of thin layers grown on III-V semiconductor substrates. Sauvage, M. (Laboratoire de Mineralogie-Cristallographie, 75 -Paris (France); Laboratoire pour l'Utilisation du Rayonnement Electromagnetique (LURE), Paris-11 Univ., 91 - Orsay (France)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The subject is discussed under the headings: introduction (description of techniques); misfit dislocations configurations in (Al,Ga)(As,P)/GaAs; plane wave analysis of III-V heterostructures; plane wave characterization of Ag/GaAs heteroepitaxy; conclusion.

26436 (DL/SCI/R—19, pp 87-89) Assessment of the properties of synchrotron radiation for a study of polytypes in silicon carbide. Fisher, G.R.; Barnes, P. (Birkbeck Coll., London (UK)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

This work describes the preliminary results of experiments carried out on the white radiation topography facility at the Daresbury synchrotron radiation source (SRS) in which the properties of synchrotron radiation are assessed for surveying the defect configurations in a large number of polytypic crystals. The study has been applied to silicon carbide but there are no reasons to suppose that the techniques could not be applied generally, indeed similar methods have been applied to zinc sulphide.

26437 (DL/SCI/R—19, pp 90-95) Damage and other changes that occur in some inorganic materials subjected to synchrotron radiation. Bhat, H.L.; Sheen, D.B.; Sherwood, J.N. (Strathclyde Univ., Glasgow (UK)). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The subject is discussed under the headings: introduction (general description of white radiation topography experiments with the Daresbury SRS); experimental; results and discussion (ammonium perchlorate - orthorhombic lattice; sodium nitrate -rhombohedral lattice; sodium chlorate - modified cubic lattice; ammonium dihydrogen phosphate - tetragonal lattice; calcium carbonate -

trigonal lattice). Mechanisms for the radiation effects observed are proposed.

26438 (EFI—587(74)-82) Investigation of monocrystal surface structure disturbances using synchrotron radiation. Karabekov, J.P.; Eghikyan, D.L.; Mikaelyan, R.A.; Bagdasaryan, V.G.; Martirosyan, M.A.; Kotsinyan, A.M.; Khachikoghlyan, S.L. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701395.

Results of the investigation of Si monocrystal surface layer defected structure by means of two-crystal topography in the Bragg geometry using synchrotron radiation are presented. Topograms obtained in high orders of reflection are shown to contain information on the structure perfection of monocrystal surface layers with thickness of several up to hundreds microns.

26439 (IAE—3562/11) Absorption of the radiation point defects by the linear edge dislocation dipoles. Turchin, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701399.

Solution of the problem of radiation point defect absorption by the parallel edge dislocation dipoles with provision for elastic interaction is obtained. Mutual effect of dislocations with antiparallel Burgers vectors changes the point defect absorption efficiency and leads to the increase of predominant interstitial atoms absorption or to the appearance of predominant vacancy absorption and dipole annealing in both cases. A mutual effect of rather remote dislocations with similar Burgers vectors doesn't change the point defect capture effectiveness during the predominant absorption of interstitial atoms.

26440 (INIS-SU—203, pp 3-26) **Problems and progress in radiation physics of semiconductors.** Vinetskij, V.L. (AN Ukrainskoj SSR, Kiev. Inst. Fiziki). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

A survey of the current status of radiation physics of semiconductors comprises the analysis of some new problems and poses the statement of concern. The essential difference between the probability of interstitial-vacancy pair occurrence W(T) in elastic collisions and the generally accepted step distribution with a typical "threshold" energy Tsub(d) is indicated. The role of diffusion and reaction evolution of primary defects leading to specific properties of the cluster formation process is shown. Special features of defect formation in spatially inhomogeneous semiconductors, in particular for elastic stresses present, are described. Among most important advances in the radiation physics of semiconductors there are the discovery of non-activation motion of the "extra" atom in silicon, the observation of a low activation energy value for the vacancy diffusion, the understanding of subthreshold mechanism of defect formation and radiation-induced diffusion, the effects of laser annealing of defects and oriented crystallization.

26441 (INIS-SU—203, pp 43-45) **Multicomponent crystal surface erosion under ion bombardment.** Opekunov, V.N. (AN SSSR, Moscow. Inst. Kristallografii); Predvoditelev, A.A. (Moskovskij Gosudarstvennyj Univ. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

The evolution of surface erosion under ion bombardment versus ion doses is studied by the vacuum decoration method. The stationary stage of the surface profile is not observed in the investigated dose range (10^{11}-$8x10^{18}$ ion cm^{-2}). The surface roughness steadily increases due to the statistical incorporation of surface defects and inhomogeneities produced at preceding stages. The development of the surface profile is influenced by the "self-contamination" of the material by one of the components sputtered from the edges of the surface steps and selectively collected in the outer surface layers.

26442 (INIS-SU—203, pp 69-70) **Radiation defects in silicon dioxide: nonbridging oxygen atoms.** Skuya, L.N.; Silin', A.R. (Latvijskij Gosudarstvennyj Univ., Riga. (USSR). Nauchno-Issledovatel'skij Inst. Fiziki Tverdogo Tela). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

Optical characteristics of non-bridging oxygen defects in vitreous SiO_2 have been measured. The absorption band at 2.0 eV and luminescence band at 1.9 eV are due to transitions between 2p states of the non-bridging oxygen split by the dynamic Jahn-Teller effect.

26443 (INIS-SU—203, pp 77-79) **Study of radiation defect formation in Au-doped n-silicon.** Alaniya, V.Sh.; Gogotishvili, M.K.; Kakhidze, N.G. 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

The effect of 3 MeV electron irradiation on electrophysical parameters of n-Si and Au-doped Si (Si <Au>), as well as on the characteristics of IC's based on them has been studied. (Before the diffusion nsub(300K)--3.5X10sup(16) and nsub(77K)=9.5x10sup(15) cm^{-3}; after the diffusjon at T=1125 deg C, nsub(300K)=3.3x10Sup(16) apd nsub(77K)=7.1x10sup(15) cm^{-3}; oxygen content was $6x10^{17}$ cm^{-3}). Experimental results of the irradiation-annealing cycle are presented. It is found that under irradiation the carrier removal rate in the Si samples is larger than that in the Si<Au> samples, while the minority carrier lifetime in Si<Au> decreases to a greater extent than that in Si without Au. To explain the difference in defect formation and annealing between Si and Si<Au>, a mechanism is suggested, based upon the fact that Au atoms are the additional centers of the vacancy capture responsible for the decrease of efficiency of acceptor-type defects introduction. To increase the IC speed, the use of Si<Au> with subsequent radiation-technological processing is recommended, since the Au solubility in Si increases due to irradiation.

26444 (Juel-Conf—36) Contributions for the third international carbon conference CARBON '80. Delle, W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). May 1980. 47p. (In German and English). (CONF-8006191—). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

This report is a compilation of 8 papers prepared by KFA Juelich GmbH for the International Carbon Conference carbon 80 in Baden-Baden. The contributions deal mainly with materials problems which arise from the application of graphite and silicon carbide in High-Temperature Gas-Cooled Reactors, HTR. Most of the results described were obtained in the framework of the HTR Projects "Hochtemperaturreaktor-Brennstoffkreislauf" (High Temperature Reactor Fuel Cycle), HBK, that includes the partners Gesellschaft fuer Hochtemperaturreaktor-Technik mbH, Hochtemperaturreaktor-Brennelement GmbH, Hochtemperatur-Reaktorbau GmbH, Kernforschungsanlage Juelich GmbH, NUKEM GmbH and Sigri Elektrographit GmbH/Ringsdorff-Werke GmbH and "Prototyp Nukleare Prozesswaerme" (Prototype Nuclear Heat), PNP, for the development of procedures for the conversion of solid fossil raw materials by means of heat from High Temperature Gas-Cooled Reactors, that includes the partners Bergbau-Forschung GmbH, Gesellschaft fuer Hochtemperaturreaktor-Technik mbH, Hochtemperatur-Reaktorbau GmbH, Kernforschungsanlage Juelich GmbH and Rheinische Braunkohlenwerke AG. Both projects are financed by the Federal Ministry for Research and Technology and the State of North Rhine-Westphalia.

26445 (Juel-Conf—36, pp 6-9) **High fluence creep behaviour of near isotropic pitch coke graphite.** Cundy, M.R. May 1980. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

Irradiation creep of graphite is highly relevant to the design of High Temperature Reactor core and reflector components. Creep rates at the high neutron fluences experienced by these components are expected to be influenced by changes in the graphite structure. The experiment reported on here, has been designed to

investigate this effect and to determine other parameters relevant in the creep process. Up to the point of maximum densification of the graphite the results indicate a stronger reduction in creep rate than had been anticipated.

26446 (Juel-Conf—36, pp 10-13) **High temperature irradiation behaviour and creep of graphitic matrix material in a low neutron flux.** Kleist, G.; Schiffers, H.; Schuster, H. May 1980. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

Irradiation testing of the graphitic matrix material A3-3 has been extended to irradiation creep in a HTR relevant neutron flux at temperatures in excess of 900°C. The A3-3 matrix, manufactured by NUKEM GmbH, Hanau, is used as the structural material for the spherical fuel elements of pebble bed High Temperature Reactors (AVR, THTR). The test results furnish evidence of a dose rate effect on the radiation creep rate (the steady state creep coefficient) at the high irradiation temperatures involved: the lower the fast neutron flux the higher the steady state creep coefficient in the flux range 2 to 6 x 10^{13} $n.cm^{-2}$ s^{-1} (DNE). A closer inspection of the free Wigner shrinkage of the unstressed reference samples shows the flux effect to be evident also in this respect. At constant irradiation temperature the shrinkage dose rate is faster for the lower flux level. The coefficient of thermal expansion and Young's modulus decrease with the accumulated tensile creep strain as compared with the reference values of unstressed companion samples. No effect of creep strain on the electrical resistivity of the A3-3 matrix can be substantiated.

26447 (Juel-Conf—36, pp 18-21) **Changes in the macroporosity of nuclear reactor graphite caused by oxygen corrsion.** Katscher, W.; Hinssen, H.K.; Moormann, R.; Delle, W.; Wallura, E. May 1980. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

The paper deals with macroporosity changes in a graphite for a nuclear high temperature reactor, which was corroded by oxygen in the in-pore diffusion controlled regime. The macroporosity was measured by means of the quantitative image analysis. The results show a strong temperature dependence of the porosity profiles but no significant influence of the oxygen partial pressure. It was found, that the porosity gradient near the surface, at which corrosion takes place, is less than in the steepest part of the porosity profile. The depth of corrosion attack remains small at temperatures above 800°C compared with characteristic dimensions of graphitic reactor components.

26448 (Juel-Conf—36, pp 22-26) **Influence of notch and specimengeometry on the deformation as well as on the fracture mechanics of a reactor graphite.** Buresch, F.E.; Mueller, T.H. May 1980. (In German). Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

Structure installations of a HTR reactor core (e.g. reflector) are planned to be performed by reactor graphite ASR-2E from Sigri-Elektrographit. For that kind of material, no realistic values of fracture-mechanics (sharp cracks) can be stated which, in certain boundaries, are independent from form and size of the specimen /1-2/. The dependence of those values from geometrical dimensions is a consequence of a remote micro-crack plasticity. This study shows in how far the degree of micro-crack plasticity is especially varied by varying the notch root radius of fracture mechanical bent specimens. It turns out that the energy release rate is closely independent from the specimen dimensions for the case that the unnotched cross section of a bent specimen is full plasticied by mikrocracking in form of a "plastic hinge". Micro-crack plasticity is demonstrated by means of isochromatic patterns of birefringent coatings.

26449 (Juel-Conf—36, pp 27-34) **Possibilities and limitations in porosity determination on graphite and carbon.** Delle, W. May 1980. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). (CONF-8006191—).

From 3. international carbon conference; Baden-Baden, F.R. Germany (30 Jun 1980).

The determination of porosity is connected with difficulties due to the various kinds and shapes of the pores as well as their wide range of sizes. The assumptions which must be made for the calculation of the pore diameters are sometimes rough approximations compared with reality. For some purposes, it is necessary to know the open porosity or pore size distribution, in other cases the total porosity may be of interest. To meet the particular requirements, a series of methods have been developed. They will be shortly described and the reasons for the limitation of their application are listed up in the tables containing advantages and disadvantages of the particular procedures.

26450 **(PNL-SA—11394) Vibrational Raman studies of particle induced damage in oxide glass.** Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 15p. (CONF-830573—10). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010951.

From 2. international conference on radiation effects in insulators; Albuquerque, NM, USA (30 May 1983).

Both bulk and glass fiber samples of $NaPO_3$ $Y(PO_3)_3$, and SiO_2 were subjected to external 5.5 MeV alpha irradiation in a nitrogen glove box from either ^{238}Pu or ^{244}Cm sources. Since damage is induced in a ca. 20 μ surface layer, thin fiber samples were chosen to optimize surface effects. All glasses developed color centers upon irradiation observed in measured uv/VIS adsorption spectra. Raman spectra of binary phosphate glasses reveal two strong bands assigned to symmetric stretching of networks P-O-P groups and terminal $>PO_2$ parallel groups which both exhibit dose dependent frequency shifts and intensity variations. Results indicate that the onset of radiation damage is manifested at nonbridging oxygen sites in the glass. The observation of nitrate stretching vibrations in alpha irradiated $NaPO_3$, a glass known to contain significant surface absorbed water, suggest that moisture enhanced radiolysis of N_2 near the glass surface has occurred. This effect was not observed for the more durable yttrium containing glass. Raman spectra of alpha irradiated fused silica show changes in accord with previous reported results for neutron compacted silica. Lines assigned to bonding defect modes in the glass intensity with increasing dose, while band intensities for network vibrational modes decreases exponentially. The implication of these results to induced microstructural changes in the glass following alpha irradiation are discussed.

26451 **(SAND—83-2012C) Role of water in densification of gels.** Gallo, T.A.; Brinker, C.J.; Klein, L.C.; Scherer, G.W. (Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Ceramics; Sandia National Labs., Albuquerque, NM (USA); Corning Glass Works, NY (USA)). Feb 1984. Contract AC04-76DP00789. 6p. (CONF-840258—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010976.

From Materials Research Society spring meeting; Albuquerque, NM, USA (27 Feb 1984).

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The densification behavior of a gel-derived borosilicate glass was studied. Surface area, thermal gravimetric and infrared measurements were used to calculate the surface hydroxyl coverage as a function of time at several temperatures. Application of a viscous sintering model to the isothermal shrinkage data showed viscosity to increase isothermally by almost two orders of magnitude at the lowest investigated temperature. Although most of this increase is attributable to increased crosslinking accompanying dehydroxylation, structural relaxation was also shown to significantly affect the densification kinetics.

26452 **(SAND—83-2173C) Infrared study of metal isopropoxide precursors for $SrTiO_3$.** Riman, R.E.; Haaland, D.M.; Northrup, C.J.M. Jr.; Bowen, H.K.; Bleier, A. (Massachusetts Inst. of Tech., Cambridge (USA); Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840258—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009929.

From Materials Research Society spring meeting; Albuquerque, NM, USA (27 Feb 1984).

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A Sr/Ti bimetallic isopropoxide complex was synthesized by two methods. The complex served as a precursor to the production of homogeneous $SrTiO_3$ powders via alkoxide hydrolysis. Infrared spectra were obtained for Sr(OPr/sup i/)$_2$, Ti(OPr/sup i/)$_4$, and the product of the syntheses. In addition, the IR spectra of the solutions of each of the alkoxides were followed as hydrolysis reactions proceeded. Detailed analysis of the spectral features support the existence of a 1:1 Sr/Ti bimetallic alkoxide. The new Sr/Ti compound exhibits characteristic absorption bands at (1017, 993, 970 cm^{-1}), (843, 838, 828 cm^{-1}), and (620, 596 and 572 cm^{-1}). Bands at 961 and 819 cm^{-1} might also be associated with the new Sr/Ti bimetallic alkoxide. The infrared spectra suggest that the isopropoxide ligands in the bimetallic alkoxide are in at least three and possibly four separate local environments. This information offers insight into possible structures for the complex.

26453 **(SAND—84-0477) Strained layer superlattice materials for millimeter wave FET's. Phase I. Final report.** Chaffin, R.J. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011475.

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Goal was the development of a semiconductor material with a superior velocity - field characteristic for use in mm wave FET's. Research was directed at increasing the saturated drift velocity and suppressing the Gunn effect by Band Structure Engineering using Strained Layer Superlattices (SLS's). The program covered theoretical analysis, crystal growth, x-ray and transport measurements and fabrication of FET's. Results were obtained on $GaAs/In_{0.2}Ga_{0.8}As$ superlattices with layer thicknesses from 45 to 300 A. Measurements have shown that the material quality of this SLS is extremely high even though the active regions contain up to 100 interfaces with built in strains due to the 1.4% lattice mismatch between GaAs and $In_{0.2}Ga_{0.8}As$. This quality manifests itself in low temperature Modulation Doped (M.D.) electron mobilities equal to or greater than those of lattice matched AlGaAs M.D. superlattices. Room temperature electron mobilities in our three-dimensional SLS's are comparable to those seen in two dimensional HEMT (High Electron Mobility Transistors) or MODFET's (Modulation Doped FET's).

26454 **(SAND—84-0510) Alkali-free phosphate glasses for high temperature, high electrical resistivity applications.** Wilder, J.A. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011533.

Alkali-free phosphate glasses have been developed in the $BaO-B_2O_3-P_2O_5$ and $BaO-Al_2O_3-P_2O_5$ systems. These glasses have glass transition temperatures $\geqq$ 500°C and coefficients of thermal expansion between 95 x 10^{-7}°C^{-1} and 118 x 10^{-7}°C^{-1}. Electrical resistivities of $\sim 10^{11}$ OMEGA-cm at 223°C compare favorably with the resistivity of fused SiO_2 of $\sim 10^{12}$ OMEGA-cm at 223°C. Hermetic seals with high strength, corrosion-resistant nickel superalloys have been made. This combination of properties make these glasses candidate materials for high temperature applications where high electrical resistivity is required.

26455 (ZfK—503, pp 52-53) **High dose oxygen implantation into silicon. A model for calculating the oxygen distribution.** Jaeger, H.U.; Hensel, E.; Kreissig, U.; Skorupa, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jun 1983. (In German). NTIS (US Sales Only), PC A09/MF A01.

In Joint annual report 1982.

26456 **Graphites for space and defense.** Eatherly, W. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 111-114(Fal 1983).

Graphite, like diamond, is crystallized carbon. In the world of commerce, graphites surpass diamonds in usefulness and economic value. The Oak Ridge National Laboratory has experimented with graphite and carbon since the beginnings of nuclear energy in the 1940's. Because of its ability to grow stronger at high temperatures, to resist radiation damage, and to slow neutrons, graphite has been used as a moderator in nuclear reactors. The ORNL program to develop manufacturing processes for graphite, to fabricate carbon and graphite materials of interest, and to study the physical and chemical properties of graphite is described.

26457 **Some basic questions in organic superconductivity.** Emery, V.J. (Brookhaven National Laboratory, Upton, N.Y. (U.S.A.)). *Journal de Physique (Paris), Colloque;* 977-982(Jun 1983). (CONF-821229—).

From Colliquium on physics and chemistry of synthetic and organic metals; Les Arcs, France (14 Dec 1982).

Several questions of current interest in the theory of organic superconductors are discussed. Particular attention is paid to the importance of low-dimensional physics, electron-electron interactions, and the specific role of the anions.

26458 **High-resolution photothermal ionization spectroscopy of lithium-related shallow donors in germanium.** Darken, L.S. (Oak Ridge National Lab., TN). *Physical Review [Section] B: Solid State;* **27**: No. 10, 6564-6567(15 May 1983). Contract W-7405-ENG-26.

High-resolution (0.10 cm^{-1} full width at half maximum) photothermal ionization spectroscopy has resolved the ground-state splitting of interstitial lithium into a singlet (E/sub 1S(A_1)/ - E/sub 2P +/-/ = 66.61 cm^{-1}) and a triplet (E/sub 1S (T_2)/ - E/sub 2P +/-/ = 66.98 cm^{-1}), and resolved four different 1S states of the D(Li,O) complex: E/sub 1S/ - E/sub 2P +/-/ = 61.75, 66.54, 67.05, and 70.50 cm^{-1}. In silicon-rich samples with [Li]>[O], a new complex, D(Li,X), was observed with E/sub 1S/ - E/sub 2P +/-/ = 70.72 and 67.24 cm^{-1}.

26459 **Heat-capacity study of phase transitions in the liquid-crystal racemic 4-(2'-methylbutyl)phenyl-4'-n-nonyloxybiphenyl-4-carboxylate (2M4P9OBC).** Viner, J.M.; Huang, C.C. (Univ. of Minnesota, Minneapolis). *Physical Review [Section] A: General Physics;* **27**: No. 5, 2763-2766(May 1983). Contract AC02-79ER10461.

The heat capacity of racemic 4-(2'-methylbutyl)phenyl-4'-n-nonyloxybiphenyl-4-carboxylate (2M4P9OBC) has been measured in the vicinity of SmC-SmI, SmI-SmG, and SmG-SmH phase transitions. The nature of the SmC-SmI transition will be discussed in the context of known microscopic pictures of each phase. In contrast to the continuous SmA-hexatic-B phase transition found in n-hexyl-4'-n-pentyloxybiphenyl-4-carboxylate, an asymmetric heat-capacity anomaly is identified in the SmC-SmI transition of 2M4P9OBC.

26460 **Annealing of vitreous silica.** Primak, W. (Argonne National Lab., IL). *Physics and Chemistry of Glasses;* **24**: No. 1, 8-18(Feb 1983).

The problem of the annealing of small plates of vitreous silica was investigated. It is concluded that it is not possible to obtain strain free small plates by annealing them mainly because of compositional changes occurring over the temperature range. A theory is developed for the kinetics of the thermal compaction. Most of the compositional changes appear to be associated with the water equilibria. The changes appear to be greatly affected by a low water vapour pressure, hence they cannot be calculated from the diffusion constants. The strains found after heating into the annealing range appear to result from differential thermal dilatations and from composition changes below the strain point. It is recommended that small plates be cut by gentle means from large blocks of vitreous silica which have undergone fine annealing rather than annealing them afterward.

26461 **Shear elastic modulus of graphite.** Grimsditch, M. (Argonne National Lab., IL). *Journal of Physics C: Solid State Physics;* **16**: L143-L144(1983).

The shear elastic modulus C_{44} of graphite was determined by Brillouin scattering from surface waves. The author's value agrees with that obtained from neutron scattering experiments but differs from those determined by ultrasonic techniques.

26462 **Nature of the smectic-A - smectic-C phase transition in liquid crystals.** Huang, C.C.; Viner, J.M. (Univ. of Minnesota, Minneapolis). *Physical Review [Section] A: General Physics;* **25**: No. 6, 3385-3388(Jun 1982). Contract AC02-79ER10461.

Experimentally high-resolution ac calorimetry measurments on a liquid-crystal compound exhibiting a smectic-A - smectic-C (SmA-SmC) phase transition which is shown to be mean-field-like is presented. In the light of this experimental result, a simple and convincing argument, based on the mean-field theory, is given to explain why non-mean-field critical exponents were obtained in many of the studies on the SmA-SmC transition. The theory not only gives an excellent fit to the data for temperatures below the transition temperature but also provides a qualitative prediction on the size of the deviation from the linear relationship between (T/ sub c/-T) and the square of the order parameter. The predicted deviation is consistent with x-ray measurements on the order parameter of another liquid-crystal compound.

26463 **EPR of luninescent glasses containing chromium(III).** Clarke, R.H. (GTE Lab., Inc., Waltham, MA); Andrews, L.J.; Frank, H.A. *Chemical Physics Letters;* **85**: No. 2, 161-165(8 Jan 1982).

The EPR spectrum at 9.19 GHz has been examined for a series of chromium(III)-doped glasses. The S = 3/2 chromium ion site in all the glasses displays two prominent transitions in the g = 6 and g = 2 region. Concentration-dependent broadening observable in the glasses at g = 2 is associated with isotropic spin exchange and provides evidence that the concentration-dependent quenching of chromium luminescence in glasses is due to an ion pairing mechanism.

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26464 **Comparison of conventional and robust regression in analysis of chemical data.** Phillips, G.R.; Eyring, E.M. (Univ. of Utah, Salt Lake City). *Analytical Chemistry;* **55**: No. 7, 1134-1138(Jun 1983).

Robust regression using iteratively reweighted least squares is described and compared with traditional least-squares regression. Application of both techniques to a collection of actual data sets demonstrates that the performance of robust regression equals, and often exceeds, that of conventional least-square regression. The practical advantages of robust methods to the chemist are discussed.

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REFER ALSO TO CITATION(S) 25249, 25326, 25329, 25329, 25381, 25393, 25400, 25527, 25583, 26534, 26535, 26888, 26984, 26985, 26986, 26989, 27006, 27054, 27220

26465 (DL/SCI/R—19, pp 11-19) **Use of synchrotron radiation for trace element analysis and element mapping by scanning X-ray fluorescence.** Davies, S.T. (Warwick Univ., Coventry (UK). Dept. of Engineering). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

Synchrotron radiation excited X-ray fluorescence is a potentially powerful tool for the routine quantitative chemical analysis of materials, with minimum detection limits typically of the order of a tenth of a ppm, and with the added advantages of simultaneous multi-element detection capability, spatial resolution on a micron scale, large signal to noise ratios and short analysis times. This paper presents a brief review of the use of synchrotron radiation in trace element analysis and discusses the requirements for a microprobe for chemical analysis utilising SR. Data obtained at the Synchrotron Radiation Source, Daresbury Laboratory include XRF spectra of standard reference materials and an application of the technique to the study of ion implanted layers in semiconductors is outlined.

26466 (DOE/ER/10624—4) **Solid surface luminescence analysis. [Progress report] November 1982-March 1984.** Hurtubise, R.J. (Wyoming Univ., Laramie (USA). Dept. of Chemistry). Apr 1984. Contract AC02-80ER10624. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011254.

Several advances were made in understanding the interactions responsible for room-temperature phosphorescence. Infrared data showed that it was possible to obtain strong room-temperature phosphorescence from compounds adsorbed on some surfaces which contained adsorbed water. A partial model for phosphor/ solid-surface interactions was developed for nitrogen heterocycles and polycyclic aromatic hydrocarbons adsorbed on poly(acrylic acid)-salt mixtures. It was discovered that hydroxyl aromatics can behave as hydrogen donors, hydrogen accepting species, or as both hydrogen donors and hydrogen acceptors when adsorbed on solid-surfaces. Several new analytical methods and techniques were developed. Poly(acrylic acid)-phosphor solutions that were spotted on filter paper resulted in lower limits of detection and better reproducibility. Both qualitative and quantitative analysis of mixtures were achieved at the nanogram level by using room-temperature fluorescence and phosphorescence. In addition, the combined use of zeroth and second derivative room-temperature fluorescence and phosphorescence spectra was developed into a useful analytical approach.

26467 (EUR—7789) **Certification of a plutonium metal reference material for chemical analysis.** Le Guidou, Y. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700939.

This report describes the characterization of a plutonium reference material for chemical analyses with accurately known plutonium content, which was prepared to meet European Community needs. A batch of a high purity plutonium metal, certified by the CEA, was available in France, and was chosen as base material. The working group discussed the work performed in France, verified the americium content and approved the CEA plutonium value.

26468 (K—2043) **Simultaneous determination of uranium and technetium by differential pulse polarography.** Powell, M.R.; Sullivan, H.H.; Oldham, T.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Mar 1984. Contract AC05-84OT21400. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010666.

A differential pulse polarographic method has been developed to simultaneously measure uranium and technetium with a solution sensitivity of 1 μg/mL U and 10 μg/L Tc. The electroanalytical method forms the basis for a proposed environmental on-stream monitor to analyze off-gases in the purge cascade at ORGDP. The design of this system will incorporate automated sampling and reporting to provide rapid and accurate determinations that are superior to methods currently being utilized.

26469 (K/PS—5017) **Transport measurements of UF_5 using a precision analysis for U^{+4}.** Jarabek, R.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 2 Apr 1984. Contract AC05-84OT21400. 20p. (CONF-840417—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010901.

From High-temperature alloys - theory and design conference; Bethesda, MD, USA (8 Apr 1984).

Transport measurements of lower valent uranium halides require precise determinations of both total U and U^{+4}. Dissolution of product from a nickel tube while maintaining the oxidation state of the uranium is required prior to determination of both total U and U^{+4} by a modified Davies-Gray analysis. Uranium^{+4} in the presence of U^{+6} can be easily titrated with standard dichromate and an overall precision of +-0.02 mg, at least between 4 and 80 mg in 100 ml of H_3PO_4. A sharp, rapid end-point is obtained by the addition of ferric ion, in addition to the vanadyl sulfate normally used as a catalyst. Nickel ion does not interfere, at least to levels of 4 mg/ml. (Al, Nb, V, Si, and Mn do not normally interfere with the Davies-Gray determination of total U, but have not been investigated).

26470 **(LA-UR—84-1325) Analytical capabilities of RIMS: absolute sensitivity and isotopic analysis.** Nogar, N.S.; Downey, S.W.; Miller, C.M. (Los Alamos National Lab., NM (USA)). 16 Apr 1984. Contract W-7405-ENG-36. 6p. (CONF-840449—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011334.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

The cw laser RIMS approach has been demonstrated to accurately measure large Lu isotope ratios and detect small levels of minor isotopes even in the presence of isobaric interferences. The same approach can also be used to obtain high resolution optical spectra of rare isotopes. For elements with higher ionization potentials (e.g., Tc), multicolor ionization schemes are necessary for cw RIMS measurements. Two-color RIMS spectra of Tc using pulsed lasers illustrate the feasibility of this approach. For any element, the sensitivity and selectivity of RIMS can be limited by the efficiency of ground state atom production in the sample volatilization step.

26471 **(LBL—17386) Optical second-harmonic generation for surface studies.** Shen, Y.R. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 5p. (CONF-8406114—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010718.

From Optical Society of America conference on lasers and electro-optics; Anaheim, CA, USA (19 Jun 1984).

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The development of optical second-harmonic generation as a tool for surface studies will be reviewed. Recent progress is discussed.

26472 **(ORNL—6039) Analytical Chemistry Division annual progress report for period ending December 31, 1983.** Lyon, W.S. (ed.). (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012044.

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Progress and activities are reported in: analytical methodology, mass and emission spectrometry, radioactive materials analysis, bio/organic analysis, general and environmental analysis, and quality assurance and safety. Supplementary activities are also discussed, and a bibliography of publications is also included. (DLC)

26473 **(ORNL/TM—9167) Sampling and analysis of cigarette smoke using the solid adsorbent Tenax.** Higgins, C.E.; Griest, W.H.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012025.

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The commercial introduction of ultra-low-tar delivery cigarette products has posed challenges in the analysis of their smoke constituents. The application of solid sorbent trapping and thermal desorption, programmed-temperature glass-capillary-column gas chromatography has proven useful for both gas phase and particulate matter analyses. In gas phase analysis the cigarette is smoked directly through a Cambridge filter and Tenax trap, and in whole smoke analysis through the Tenax trap alone. For cigarettes having deliveries of < 1 mg tar/cigarette the entire trap content, or a fraction thereof, is desorbed at 250°C in the injection port of the gas chromatograph, and the cryothermally trapped organic desorbate is separated by programmed temperature gas chromatography. Tenax used to trap smoke from higher tar delivery cigarettes is duluted with clean Tenax and homogenized before analysis. Quantitation is made by the method of external standards, the RSD for smoke components averaging generally +-20%. Higher RSD's of +-60% in the case of some ultra-low cigarette smoke components may be influenced by mainstream enrichment by sidestream smoke drifting near the air dilution vents in the filter rod. This method of analysis when applied to whole smoke can determine the entire cigarette delivery of many gas phase and particulate matter components, and has sufficient sensitivity that flavor related components in cigarette smoke are analyzable. The distribution of some semivolatile components between gas and particulate phases has been determined by application of this method and is reported.

26474 **(PB—84-152016) Neodecanoic acid as a Co3+ solvent extractant. Report of investigations/1983.** Penner, L.R.; Traut, D.E.; Henry, J.L. (Bureau of Mines, Albany, OR (USA). Albany Research Center). Dec 1983. 17p. (BM-RI—8826). NTIS, PC A02/MF A01.

The Bureau of Mines conducted solvent extraction batch tests to evaluate the usefulness of neodecanoic acid (NDA) for extracting Co3+ from ammoniacal leach liquors high in ammonium sulfate. This work is an out-growth of previous Bureau research in which technology was devised for the recovery of cobalt, nickel, and byproduct copper from domestic laterites. This report deals with the subsequent solvent extraction of cobalt from the nickel-copper raffinate solution. The fundamental problem, common to all extractants of the cobaltic ammines, is discussed, and an alternative for recovering cobalt metal from loaded solvent by a hydrogen-reduction method is also discussed.

26475 **(UCRL—89876) GRPANL: a program for deconvoluting and interpreting complex peak clusters.** Gunnink, R.; Ruhter, W.D.; Niday, J.B. (Lawrence Livermore National Lab., CA (USA)). 23 Mar 1984. Contract W-7405-ENG-48. 11p. (CONF-840408—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009609.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

GRPANL (GRouP ANaLysis) is a general-purpose peak fitting program that first determines gamma-ray and x-ray energies and intensities for specified peaks or clusters of peaks in a spectrum and then proceeds to interpret these results, determining both the radioisotopes detected and the amounts of each in the sample. Versions of the program are now running on the Digital Equipment Corporation (DEC) VAX and PDP-11 computers. The code has several unique capabilities for deconvoluting and interpreting difficult analytical situations that other codes usually cannot handle.

26476 **Octanol-water partition coefficient of benzo(a)pyrene: measurement, calculation, and environmental implications.** Mallon, B.J.; Harrison, F.L. (Univ. of California, Livermore). *Bulletin of Environmental Contamination and Toxicology;* **32**: No. 3, 316-323(Mar 1984). Contract W-7405-ENG-48.

Benzo(a)pyrene (BaP) is a potent carcinogen produced in significant quantities during pyrolysis of such substances as coal, wood, and cigarettes. Several researchers have shown that the lipophilic storage and soil sediment accumulation of many organic solutes is proportional to the partitioning between octanol-1 and water. The octanol-water partition coefficient (P) is defined as P = C/sub o//C/sub w/, where C/sub o/ and C/sub w/ are the concentration of the solute in n-octanol and water. Considerable data are available demonstrating that P values measured in the laboratory can be used to predict the environmental behavior of organic pollutants. Literature searches reveal that calculated, but not measured, log P values are reported for BaP. This laboratory study was initiated to define better the log P of BaP.

26477 **Carbon-13 nuclear magnetic resonance studies of a solid inclusion complex.** Early, T.A. (Colorado State Univ., Fort Collins); Haw, J.F.; Bax, A.; Maciel, G.E.; Puar, M.S. *Journal of Physical Chemistry;* **88**: No. 2, 324-327(19 Jan 1984). Contract AS20-81LC10652.

A solid inclusion complex containing n-hexane as the mobile guest component was studied via cross polarization nuclear magnetic resonance techniques. The hexane is found to yield a cross polarization spectrum, demonstrating that its motion in the lattice is anisotropic. The hexane also yields a relatively sharp spectrum with the proton decoupler off, showing reduced ^{1}H-^{13}C scalar splittings. A theory developed by Sack and Pople to account for the effect of ^{14}N relaxation on the appearance of the ^{1}H spectrum of NH_3 is applied here to account for the reduced splitting in terms of a proton-proton flip-flop mechanism. A flip-flop rate of 110-135 s^{-1} is determined for the methylene groups. The ^{13}C spin-spin relaxation time

is used in a rough characterization of rotational motion of the hexane. The qualitative correlation time obtained is intermediate between that for a liquid and that for a rigid solid. 7 figures.

26478 **Improved procedure for high purity gaseous peroxyacyl nitrate production: use of heavy lipid solvents.** Gaffney, J.S.; Fajer, R.; Senum, G.I. (Brookhaven National Lab., Upton, NY). *Atmospheric Environment;* **18**: No. 1, 215-218(1984). Contract AC02-76CH00016.

An improved procedure is described for the production of peroxyacyl nitrates (PAN's) in the gas phase. The method of Nielsen et al. (1982) has been modified to yield PAN's of high purity with no further chromatographic purification required. Extraction of PAN's from the nitration of the peracids is accomplished by use of a heavy lipid solvent (n-tridecane). This solvent's low vapor pressure allows the simple separation and preparation of high purity gaseous PAN's (>98%) as determined by Fourier transform infrared spectroscopy (FTIR). Using this method infrared integrated band strengths are reported for peroxyacetyl nitrate (PAN) perdeutero-peroxyacetyl nitrate (PAN-D_3) and peroxyproprionyl nitrate (PPN). The method allows facile production of large amounts of gaseous PAN's for smog chamber and laboratory studies, toxicological and health effects research, as well as for calibration of PAN analyses.

26479 **Mass spectrometry with direct supercritical fluid injection.** Smith, R.D.; Udseth, H.R. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **55**: No. 14, 2266-2272(Dec 1983). Contract AC06-76RL01830.

Direct fluid injection mass spectrometry utilizes supercritical fluids for solvation and transfer of materials to a mass spectrometer chemical ionization (CI) source. Available data suggest that any material soluble in a supercritical fluid is transferred efficiently to the ionization region. Mass spectra are presented for mycotoxins of the trichothecene group obtained by use of supercritical carbon dioxide with isobutane as the CI reagent gas. Direct fluid injection MS/MS is also illustrated for major ions in the isobutane chemical ionization of T-2 toxin. The effect of pressure and temperature upon solubility in supercritical fluids is described and illustrated for diacetoxyscirpenol. A potential method is also demonstrated for "on-line fractionation" during MS analysis using pressure to control supercritical fluid solubility. Mass spectra are also presented for polar compounds, using supercritical ammonia, and the extension to complex mixtures is described. The fundamental basis and experimental requirements of the direct fluid injection process are discussed. 1 figure, 11 tables.

26480 **Determination of aromatic hydrocarbons in particulate samples by high-temperature extraction and Shpol'skii spectrometry.** Renkes, G.D.; Walters, S.N.; Woo, C.S.; Iles, M.K.; D'Silva, A.P.; Fassel, V.A. (Ames Lab., IA). *Analytical Chemistry;* **55**: No. 14, 2229-2231(Dec 1983). Contract W-7405-ENG-82.

A rapid high-temperature (240°C) extraction with ~ 2 mL of diphenylmethane is utilized for the determination of polynuclear aromatic hydrocarbons in particulate samples. Direct quantitation is accomplished by laser excited Shpol'skii spectrometry (LESS) after an aliquot of the extract is diluted with n-octane. 2 figures, 4 tables.

26481 **Sampling and determination of boron in the atmosphere.** Fogg, T.R. (Univ. of Rhode Island, Narragansett); Duce, R.A.; Fasching, J.L. *Analytical Chemistry;* **55**: No. 13, 2179-2184(Nov 1983). Contract FG22-82PC51260.

Atmospheric boron has been separated into gaseous and particulate components simultaneously for the first time by passing air through a simple impregnated filter sampling system. A Nuclepore filter for particulate boron collection preceded KOH impregnated Whatman 41 filters for gaseous boron collection. The filters were contained in a single 47-mm filter holder. Boron was determined by visible spectrophotometry with 2,4-dinitro-1,8-naphthalenediol (DNNDO) and brilliant green. Results obtained during field use at a variety of sampling sites around the United States reveal that the gaseous fraction is the major (> 96%) phase of atmospheric boron and suggest that much of the gaseous fraction of boron may exist as $B(OH)_3$. The ease, precision, and low detection limit of the DNNDO method for boron analysis are ideally suited for use with impregnated filter collection of boron, and the DNNDO method allows short time scale (daily) variations of atmospheric boron to be measured. 1 figure, 5 tables.

26482 **Isolation and identification of amino polycyclic aromatic hydrocarbons from coal-derived products.** Later, D.W.; Andros, T.G.; Lee, M.L. (Brigham Young Univ., Provo, UT). *Analytical Chemistry;* **55**: No. 13, 2126-2132(Nov 1983). Contract AC02-79EV10237;AC06-76RL01830.

A method is described for the complete separation of the amino polycyclic aromatic hydrocarbons (amino-PAH) from complex coal-derived mixtures. Prefractionation of crude materials is achieved by a previously described two-step alumina/silicic acid adsorption column chromatographic procedure. Next, derivatization with pentafluoropropionic anhydride of the amino-PAH-rich isolate of an SRC II heavy distillate coal liquid enabled the complete separation of this chemical class from other isomeric nitrogen-containing polycyclic aromatic compounds by gel permeation chromatography on Bio-Beads SX-12. Finally, the fluoroamide derivatives were converted back to the orginal amino functionality by catalytic hydrolysis on neutral aluminum oxide. Subsequent high-resolution separation of individual components was achieved by capillary column gas chromatography, and specific compounds were determined by gas chromatographic retention data and gas chromatography/mass spectrometry. Several parent two-, three-, and four-ring amino-PAH, as well as many alkylated homologues, were identified in this complex coal-derived liquid. 6 figures, 3 tables.

26483 **Separations by supported liquid membrane cascades.** Danesi, P.R. (to Dept. of Energy). US Patent Application 6-528,510. 1 Sep 1983. 23p. Contract W-31-109-ENG-38.

The invention describes a new separation technique which leads to multi-stage operations by the use of a series (a cascade) of alternated carrier-containing supported-liquid cation exchanger extractant and a liquid anion exchanger extractant (or a neutral extractant) as carrier. The membranes are spaced between alternated aqueous electrolytic solutions of different composition which alternatively provide positively charged extractable species and negatively charged (or zero charged) extractable species, of the chemical species to be separated. The alternated aqueous electrolytic solutions in addition to providing the driving force to the process, simultaneously function as a stripping solution from one type of membrane and as an extraction-promoting solution for the other type of membrane. The aqueous electrolytic solution and the supported liquid membranes are arranged to provide a continuous process.

26484 **Microbore liquid chromatography with flow cell Fourier transform infrared spectrometric detection.** Brown, R.S.; Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Analytical Chemistry;* **55**: No. 9, 1492-1497(Aug 1983). Contract FG22-81PC40799.

Fourier transform infrared spectrometry (FTIR) has been used as a detector for microbore high-performance liquid chromatography (HPLC) through the use of a low volume transmission flow cell. Characteristics of the system have been determined and compared with analytical scale HPLC separations with FTIR detection. Improvement in sensitivity is reported for the microbore scale system over the analytical scale system. Direct comparison of the detection limits considering equal quantities injected for 2,6-di-tert-butylphenol is made for both systems. 9 figures, 1 table.

26485 **Selection of atomic emission lines for tunable atomic line molecular spectrometry of benzene.** Hadeishi, T. (Univ. of California, Berkeley); McLaughlin, R.D.; Conway, J.G.; Scott, D.R. *Analytical Chemistry;* **55**: No. 9, 1517-1519(Aug 1983). Contract AC03-76SF00098.

A method of locating appropriate atomic emission lines for the detection of complex molecules, e.g., benzene, with the tunable atomic line molecular spectrometry (TALMS) technique is described. Atomic emission spectra are superimposed upon medium- to high-resolution absorption spectrograms of the molecules. It is

then possible to estimate relative sensitivities associated with the various TALMS signals at different wavelengths from the Zeeman splitting patterns and the molecular absorption spectra. The TALMS signal is shown to be determined by the extinction coefficient difference, $\Delta\epsilon$, a concentration-independent parameter. $\Delta\epsilon$ for benzene at the Co 252.8 nm and Hg 253.7 nm lines is estimated from photographic measurement to be 100 and 8.4, respectively. The experimental TALMS signals using these lines are in the ratio 35:1. 5 figures.

26486 Determination of reactive components in silicone foams. Dubiel, S.V.; Griffith, G.W.; Long, C.L.; Baker, G.K.; Smith, R.E. (Bendix Corp., Kansas City, MO). *Analytical Chemistry;* **55**: No. 9, 1533-1537(Aug 1983). Contract AC04-76DP00613.

Analytical methods have been developed for the determination of reactive components used in the formulation of room temperature vulcanized (RTV) silicone foams. The reactive components include total silanol (SiOH), silane hydrogen (SiH), tetrapropoxysilane (TPS), and diphenylmethylsilanol (DPMS). Total SiOH and SiH are determined by Fourier transform infrared (FTIR) spectrometry. The SiOH peak at 3687 cm^{-1} were used for quantitation. The TPS content was determined by gas chromatography (GC), using a solid capillary open tubular (SCOT) column and linear programmed temperature control. The DPMS content was determined by gel permeation chromatography (GPC) using THF solvent. 4 figures, 4 tables.

26487 Quantitative analysis without analyte identification by refractive index detection. Synovec, R.E.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **55**: No. 9, 1599-1603(Aug 1983). Contract W-7405-ENG-82.

Contrary to the accepted notion that qualitative analysis must precede quantitative analysis, the authors show that one can determine the volume fraction of an arbitrary analyte in a flowing system without knowing its identity. The physical and chemical properties of the analyte are thus unknown, and no working curve can be established. The scheme is based on the refractive index detector, which produces two distinct responses for the same analyte when two separate eluents are used. The information obtained can be used to predict the volume fraction of the analyte, as well as its refractive index. Experimental verification of this scheme is reported. 1 figure, 2 tables.

26488 Time-resolved laser-induced breakdown spectrometry of aerosols. Radziemski, L.J.; Loree, T.R.; Cremers, D.A.; Hoffman, N.M. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 8, 1246-1252(Jul 1983).

The repetitive breakdown spark from a focused laser beam was used to generate analytically useful emission spectra of aerosols in air. The apparatus is simple; a pulsed laser and optics, a spectrometer, and some method for time resolution of the spark light. Time resolution is essential because of the strong continuum emission at early times (<500ns). High temperatures in the spark result in vaporization of small particles, dissociation of molecules, and excitation of atomic and ionic spectra. The plasma acts as if it were in local thermodynamic equilibrium, at least after 1 μs. Spectroscopic methods have been used to measure the time-resolved temperatures and electron densities. A simple one-dimensional hydrodynamic model predicts the temperature and diameter of the spark. Beryllium in atmospheric pressure air has been detected at 0.7 3=g/m^3, which is 0.6 ng/g of air (RSD = 30%). Limits of detection have also been established for Na, P, As, and Hg in air. A calibration curve linear over 4 orders of magnitude has been developed for Na in air. In situ experiments have been performed on two experimental coal gasification systems, and real-time spectral information has been obtained in both cases. 9 figures, 2 tables.

26489 Improved graphite furnace atomizer. Siemer, D.D. (to Dept. of Energy). US Patent Application 6-495,888. 18 May 1983. 23p. Contract AC07-79ID01675.

A graphite furnace atomizer for use in graphite furnace atomic absorption spectroscopy is described wherein the heating elements are affixed near the optical path and away from the point of sample deposition, so that when the sample is volatilized the spectroscopic temperature at the optical path is at least that of the volatilization temperature, whereby analyteconcomitant complex formation is advantageously reduced. The atomizer may be elongated along its axis to increase the distance between the optical path and the sample deposition point. Also, the atomizer may be elongated along the axis of the optical path, whereby its analytical sensitivity is greatly increased.

26490 Method of using a nuclear magnetic resonance spectroscopy standard. Spicer, L.D.; Bennett, D.W.; Davis, J.F. (to Dept. of Energy). US Patent Application 6-492,926. 9 May 1983. 20p. Contract AC02-76ER02190.

$(CH_3)_3SiNSO$ is produced by the reaction of $((CH_3)_3SI)_2NH$ with SO_2. Also produced in the reaction are $((CH_3)_3Si)_2O$ and a new solid compound $[NH_4][(CH_3)_3SiOSO_2]$. Both $(CH_3)_3SiNSO$ and $[NH_4][(CH_3)_3SiOSO_2]$ have fluorescent properties. The reaction of the subject invention is used in a method of measuring the concentration of SO_2 pollutants in gases. By the method, a sample of gas is bubbled through a solution of $((CH_3)_3Si)_2NH$, whereby any SO_2 present in the gas will react to produce the two fluorescent products. The measured fluorescence of these products can then be used to calculate the concentration of SO_2 in the original gas sample. The solid product $[NH_4][(CH_3)_3SiOSO_2]$ may be used as a standard in solid state NMR spectroscopy, wherein the resonance peaks of either ^1H, ^{13}C, ^{15}N, or ^{29}Si may be used as a reference.

26491 Membrane electrode for the determination of actinyl(VI) cations. Bertrand, P.A.; Choppin, G.R.; Lin, F.R.; Bunzil, J.C.G. (Florida State Univ., Tallahassee). *Analytical Chemistry;* **55**: No. 2, 364-367(Feb 1983).

A coated wire specific electrode has been developed for actinyl(VI) cations. The electrode responds in Nernstian fashion to actinyl(VI) concentrations of 10^{-5} - 10^{-2} M between pH 2 and 5. The interference by M(I), M(II), M(III), and MO_2^+ cations is small even when $[M(III)]:[An(anion)O_2^{2+}] \approx 10$. However, Th(IV) does interfere. The electrode can be used in complexation and redox studies of UO_2^{2+}, NpO_2^{2+}, and PuO_2^{2+} within its useful range of pH and AnO_2^{2+} concentration.

26492 Detection of plutonium by resonance ionization mass spectrometry. Donohue, D.L.; Young, J.P. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **55**: No. 2, 378-379(Feb 1983). Contract W-7405-ENG-26.

The goal of this study was to demonstrate that RIMS (resonance ionization mass spectrometry) might be applicable to Pu isotopic measurements and also to explore the analytical parameters of such measurements. 1 table.

26493 Ionization spectra of neodymium and samarium by resonance ionization mass spectrometry. Young, J.P.; Donohue, D.L. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **55**: No. 1, 88-91(Jan 1983). Contract W-7405-ENG-26.

Ionization spectra of the elements neodymium and samarium have been obtained over the wavelength range of 423-463 nm by using the technique of resonance ionization mass spectrometry (RIMS). These studies have been performed to determine the wavelengths at which ionization occurs under RIMS conditions. The observed wavelengths have been correlated where possible with allowed transitions between known electronic energy levels. RIMS has previously been applied to the measurement of isotope ratios of these rare earth elements using a single wavelength of excitation for each element. The fact that there are a number of effective wavelengths available should be of interest to other workers in the RIMS field.

26494 Ionization spectra of neodymium and samarium by resonance ionization mass spectrometry. Young, J.P.; Donohue, D.L. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **55**: No. 1, 88-91(Jan 1983). Contract W-7405-ENG-26.

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have previously been applied to the measurement of isotope ratios of these rare earth elements using a single wavelength of excitation for each element. The fact that there are a number of effective wavelengths available should be of interest to other workers in the RIMS field.

26495 Detection of chlorine and fluorine in air by laser-induced breakdown spectrometry. Cremers, D.A.; Radziemski, L.J. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 8, 1252-1256(1983).

The use of laser-induced breakdown spectrometry (LIBS) to spectrometrically detect chlorine and fluorine if air directly is investigated. A laser-generated spark is used to atomize chlorine- and fluorine-bearing molecules. The atoms are then electronically excited by the high temperatures of the spark. Emission from the neutral atoms is spectrally and temporally resolved to maximize the signal-to-noise ratio. Optimization of the time window and laser power for minimum detection limits is discussed. The use of LIBS to determine the ratios of the numbers of different types of atoms on a molecule is considered. Minimum detectable concentrations of chlorine and fluorine in air are 8 and 38 ppm (w/w), respectively. Minimum detectable masses of chlorine and fluorine are, respectively, 80 ng and 2000 ng in air and 3 ng for both atoms in He. The precision for replicate sample analysis is 8% RSD. 3 figures, 4 tables.

26496 Neutron-activation study of figurines, pottery, and workshop materials from the Athenian Agora, Greece. Fillieres, D.; Harbottle, G.; Sayre, E.V. (Brookhaven National Lab., Upton, NY). *Journal of Field Archaeology;* **10**: 55-69(1983).

Ceramic specimens from the excavations of the Agora of ancient Athens, Greece, including material from factories, i.e., trial firing pieces, pottery and figurine wasters, datable to the Protogeometric, Subgeometric, and Classical Periods, and stylistically related figurines and pottery were analyzed by neutron activation. The factory material from the three distinct chronological periods separated respectively into three significantly different compositional groups, indicating either that separate sources of clay were used during each of these periods or that some other significant changes in the traditions of fabrication had occurred. Many of the figurines and sherds analyzed coincided in composition with one of these three groups and therefore were shown to be consistent with the output of Athenian workshops. Some specimens of Corinthian style formed a separate compositional group as did some other specimens that agreed in composition with a clay from Aegina. Comparison of these results with previous analyses on file in the Brookhaven Data Bank revealed a number of specimens that corresponded both in style and composition to the Agora material. Most significant was a sizable amount of Classical Greek pottery excavated in southern France, in Israel, and in Cyprus that conformed in composition to the Attic Classical Group. 6 figures, 2 tables.

26497 Angle-resolved photoelectron spectroscopy of benzene and hexafluorobenzene as a function of photon energy. Mehaffy, D. (Univ. of Wisconsin, Madison); Keller, P.R.; Taylor, J.W.; Carlson, T.A.; Grimm, F.A. *Journal of Electron Spectroscopy and Related Phenomena;* **28**: 239-247(1983). Contract W-7405-ENG-26.

Angle-resolved photoelectron spectra of benzene have been recorded using synchrotron radiation as the photon source. From these results the angular distribution parameter β has been extracted for the first three orbitals; 1e/sub 1g/(π), 3e/sub 2g/(σ) and 1a/sub 2u/(π). Calculations of β employing the MS Xα method have also been carried out. Agreement between experiment and theory for the first two orbitals is excellent. Poor agreement in the core of the third orbital is believed to be due to overlap of the second and third bands in the photo-electron spectra. This has been verified by data obtained for perfluorobenzene. The unversality of the energy dependence of β for π orbitals, noted previously for unsaturated aliphatic compounds, has been extended to aromatic systems. The importance of the results for benzene for the future application of angle-resolved photoelectron spectroscopy to complex molecules is indicated. 6 figures.

26498 Absorption cell with fiber optics for concentration measurements in a flowing gas stream. Saturday, K.A. (Savannah River Lab., Aiken, SC). *Analytical Chemistry;* **55**: 2459-2460(1983). Contract AC09-76SR00001.

To facilitate the connection of the fiber optics to the experimental apparatus, the optical system was kept simple. Delicate alignments were avoided since the apparatus was contained in a glovebox and access to the monitor cells was limited. Changing the analysis site from one monitor cell to another was a trivial operation, allowing a single light source and detector assembly to service all experimental configurations. The in-line absorption cell was utilized to study the preparation of uranium and plutonium hexafluorides in a flowing system.

26499 Flowing afterglow in argon and helium: differences in two reactor designs in application to the analysis of moisture. Bystroff, R.I.; Stout, N.D. (Lawrence Livermore National Lab., CA). *Journal of Hazardous Materials;* **7**: 223-232(1983). Contract W-7405-ENG-48.

Excitation by rare gas metastables in a glow discharge afterglow is effective for the sensitive chemiluminescent detection of trace moisture. In the development of a flowing afterglow (FLAG) system for the study of effluent gases from high explosives, two approaches were taken in the design of a modular reactor. A glass reactor system with a tantalum shell hollow cathode source isolated by a Woods horn was compared to a 3 in. dia. steel reactor in which the reactor entrance port acts as the cathode. The sensitivity of both systems increases linearly with currents up to 15 mA in operation at 1 Torr argon or helium. The steel reactor provides an order of magnitude greater sensitivity for OH than the glass reactor. A continuous moisture background at 60°C over vacuum dried nitrocellulose of 0.9 nmol/g-s (0.02 ppm) is demonstrated. With the steel system a photon count sensitivity for OH at 308.9 nm of 30000 counts/nmol in argon and 5200 counts/nmol in helium is obtained using a 0.4 nm bandpass. 3 figures, 3 tables.

26500 Laser studies of radiationless decay mechanisms in Os/sup 2+/3+/ polypyridine complexes. Netzel, T.L.; Bergkamp, M.A. (Brookhaven National Lab., Upton, NY). *ACS Symposium Series;* No. 211, 515-518(1983).

The results of picosecond absorption studies show a lack of significant change with decreasing temperature (295 K to 10 K) on the lifetimes of the ligand-to-metal charge transfer (LMCT) in the OsL_3^{3+} complexes; L = 2,2′ bipryridine (bpy) or 1,10 phenanthroline(phen). The LMCT lifetimes at low temperature are then contrasted with the low temperature lifetimes of the metal-to-ligand charge transfer (MLCT) states of the OsL_3^{2+} complexes and both are examined from the perspective of a radiationless theory developed by Englman and Jortner. Mid-frequency vibrations (1300-1600 cm^{-1}) are the important energy accepting modes for radiationless decay of the charge transfer excited states of OsL3/sup 2+/3+/, and the 10^5 - 10^6 differences in lifetimes between MLCT states of OsL_3^{2+} complexes and the LMCT states of OsL_3^{3+} complexes is largely due to the difference in their energy gaps. 1 table.

26501 Determination of uranium in aqueous samples by laser-induced fluorescence spectrometry. Whitkop, P.G. (Savannah River Lab., Aiken, SC). *Analytical Chemistry;* **54**: No. 14, 2475-2477(Dec 1982). Contract AC09-76SR00001.

A new pulsed laser method suitable for trace analysis of uranium in plutonium process stream samples containing large quantities of fluorescence quenchers has been developed. This technique includes the extraction of uranium from an aqueous sample into trin-butyl phosphate, with subsequent striping into dilute phosphoric acid. A standard addition method is incorporated into the analysis. Analytical data show that a detection limit of 1 ppB for a particular matrix has been achieved. The precision of the analysis is in the range of +/-7% relative standard deviation. Variation of these results with sample matrix and analytical procedure is discussed. 2 figures.

26502 Multicomponent mixture analysis by multidimensional phosphorimetry. Ho, C.N.; Warner, I.M. (Texas A and M Univ., College Station). *Analytical Chemistry;* **54**: No. 14, 2486-2491(Dec 1982). Contract AS05-80EV10404.

A technique based on the rapid scanning capability of the video fluorometer to acquire an emission-excitation matrix (EEM) has been developed for phosphorimetry. This technique overcomes the problem of convolution of time decay with phosphorescence excitation and emission spectra by integrating the signal on target. This method also circumvents the need for very rapid acquisition of data for samples with phosphors of very short lifetimes. A phosphorescence emission-excitation matrix (PEEM) obtained in this manner permits time resolution. Sets of each time-PEEM allow a ratio deconvolution algorithm to successfully resolve mixtures of polynuclear aromatic compounds. 9 figures.

26503 Matrix and solvent effects on the room-temperature phosphorescence of nitrogen heterocycles. Ramasamy, S.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **54**: No. 14, 2477-2481(Dec 1982). Contract AC02-80ER10624.

Several experimental parameters were studied to enhance the room-temperature phosphorescence of nitrogen heterocycles adsorbed on polyacrylic acid-salt mixtures and filter paper. The room-temperature phosphorescence was very sensitive to the salt content of the solid surface and the solvent used to adsorb the phosphor onto the surface. Sodium chloride and methanol were particularly important for inducing strong room-temperature phosphorescence. The results obtained partially explain some of the interactions responsible for room-temperature phosphorescence from nitrogen heterocycles. 2 figures, 5 tables.

26504 Immobilized enzyme system for the conversion of benzo[a]pyrene to fluorescent metabolites. Walters, S.N.; D'Silva, A.P.; Fassel, V.A. (Iowa State Univ., Ames). *Analytical Chemistry;* **54**: No. 14, 2571-2576(Dec 1982). Contract W-7405-ENG-82.

The enzyme aryl hydrocarbon hydroxylase (AHH) immobilized on a polyacrylamide support poly(acrylamide-co-N-acryloxysuccinimide) has been utilized for the enzymatic conversion of benzo[a]pyrene (B[a]P) to 3-hydroxybenzo[a]pyrene (3-OH-B[a]P), a fluorescent metabolite. Because the procedure mimics reactions occurring in mammalian tissues, the measurement of the fluorescence of 3-OH-B[a]P offers promise as a means of assessing the potential mutagenicity of B[a]P occurring in complex mixtures. 8 figures, 2 tables.

26505 Separation of tervalent lanthanides from actinides by extraction chromatography. Martin, D.B.; Pope, D.G. (Radiological and Environmental Sciences Lab., Idaho Falls, ID). *Analytical Chemistry;* **54**: No. 14, 2552-2556(Dec 1982).

A procedure is described for the removal of milligram amounts of lanthanides from the tervalent actinides. The routine application of an earlier procedure resulted in low americium yields and poor resolution of the) spectrum, mainly due to inadequate removal of neodymium. The reported procedure offers many significant improvements and involves prepurification of the lanthanide-actinide fraction by precipitation as a hydroxide, removal of the lanthanides from the tervalent actinides by extraction on a column of bis(2-ethylhexyl)-phosphoric acid sorbed on Teflon powder, and carrying the actinides directly from the eluate on about 50 μg of cerium fluoride for) spectrometry. The actinide recovery from a mixture of 5 mg of cerium, 3 mg of lanthanum, and 2 mg of neodymium was 86% for californium and 96% for americium and curium, with less than 10 μg of the neodymium remaining. The average overall recovery of americium from routine analysis of 131 soil samples was 84 +/- 6%. 4 figures, 1 table.

26506 Data acquisition and processing modes for quantitative Auger electron spectroscopy. Burrell, M.C.; Kaller, R.S.; Armstrong, N.R. (Univ. of Arizona, Tucson). *Analytical Chemistry;* **54**: No. 14, 2511-2517(Dec 1982).

Auger electron spectroscopy has been applied to the quantitative surface analysis of a series of metals (Ag, Cd, In, Sn), indium-tin alloys, indium and tin oxides, and indium-tin oxide (ITO) films. Spectra were obtained by two methods: the conventional modulation technique, which results in the derivative spectrum, and a direct current measurement, which gives an undifferentiated spectrum. For data collected in the latter mode, an instrumental approach and secondary electron background correction are discussed. Quantitative results obtained by using this approach are shown to be more accurate than the traditional measurement method. 7 figures, 3 tables.

26507 Competitive transport of alkali metal ions from aqueous solutions into toluene by highly lipophilic crown ether carboxylic acids. Charewicz, W.A.; Bartsch, R.A. (Texas Tech Univ., Lubbock). *Analytical Chemistry;* **54**: No. 13, 2300-2303(Nov 1982). Contract AS05-80ER10604.

Efficiencies and selectivities of competitive alkali metal transport into toluene by 2-[(sym-dibenzo-16-crown-5)oxyl]-decanoic acid and [sym-bis[4(5)-tert-butylbenzo]-16-crown-5]oxy]acetic acid are determined in solvent extraction, bulk liquid membrane transport, and liquid surfactant membrane transport (water-in-oil-in-water emulsion) and compared with those previously measured for solvent extraction and bulk liquid membrane transport with chloroform as the organic phase. 4 figures, 2 tables.

26508 Constant energy synchronous fluorescence for analysis of polynuclear aromatic hydrocarbon mixtures. Inman, E.L. Jr.; Winefordner, J.D. (Univ. of Florida, Gainesville). *Analytical Chemistry;* **54**: No. 12, 2018-2022(Oct 1982). Contract AS05-78EV06022.

Constant energy synchronous luminescence has been developed to improve the selectivity of luminescence techniques. If the authors scan the excitation and emission monochromators simultaneously, synchronized so that a constant energy difference is maintained between the wavelengths, considerable improvements are made over conventional synchronous techniques. The foundational concepts of this method are described, correlating experimental parameters with luminescence theory. Experimental parameters are, therefore, more easily optimized. 6 figures, 1 table.

26509 Optimization of a flow injection analysis system for multiple solvent extraction. Rossi, T.M.; Shelly, D.C.; Warner, I.M. (Texas A and M Univ., College Station). *Analytical Chemistry;* **54**: No. 12, 2056-2061(Oct 1982). Contract AS05-80EV10404.

The performance of a multistage flow injection analysis solvent extraction system has been optimized. The effect of solvent segmentation devices, extraction coils, and phase separators on performance characteristics is discussed. Theoretical consideration is given to the effects and determination of dispersion and the extraction dynamics within both glass and Teflon extraction coils. The optimized system has a sample recovery similar to an identical manual procedure and a 1.5% relative standard deviation between injections. Sample throughput time is under 5 min. These characteristics represent significant improvements over the performance of the same system before optimization. 6 figures, 2 tables.

26510 Collision-induced dissociation with Fourier transform mass spectrometry. Cody, R.B.; Burnier, R.C.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Analytical Chemistry;* **54**: No. 1, 96-101(Jan 1982). Contract AC02-80ER10689.

Collision-induced dissociations (CID) is demonstrated on a number of primary and secondary ions using a Nicolet prototype Fourier transform mass spectrometer (FT-MS). Like the triple quadrupole technique, CID using FT-MS is a relatively low energy and efficient process. The ability to study a wide range of ion-molecule reaction products is exemplified by results on proton-bound dimers and transition metal containing ionic species. Variation of collision energy by varying the RF irradiation level can provide information about product distributions as a function of energy as well as yield ion structural information. Like the triple quadrupole technique, no slits are employed and virtually all of the fragment ions formed by the CID process may be detected. Unlike all previous mass spectrometric techniques for studying CID, a tandem instrument is not required, and different experiments are performed by making software modifications rather than hardware modifications.

26511 **Collision region for mass spectrometry/mass spectrometry.** Glish, G.L.; Todd, P.J. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **54**: 842-843(1982). Contract W-7405-ENG-26.

Mass spectrometry/mass spectrometry is fast becoming a valuable analytical technique. An integtral part of this technique is the fragmentation of the parent ion. A large number of fragmentation pathways are supplied through the use of collision induced dissociations. Some typical designs of chambers for these collisions are presented. The efficiency of collision induced dissociation, defined as the current of fragmented ions divided by the current of parent ions, is determined. This efficiency is a combination of the fragmentation efficincy and the collection efficiency.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 25252, 25253, 26038, 26268, 26486, 26530, 26531, 26536, 26555, 26570

26512 **(BMFT-FB-T—83-273) Physical and chemical investigations on real catalyst surfaces.** Bayer, G.; Fitzky, H.G.; Holm, R.; Keiser, H.; Menold, R.; Mueller, G.; Oppermann, G.; Scharschmidt, J.; Storp, S.; Imre, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 199p. (In German). NTIS (US Sales Only), PC A09 MF/A01. Order Number DE84750945.

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For the study of catalysts under reaction conditions which approximate the technical ones as far as possible, various methods of physical analysis have been implemented and improved in instrument with attached micro-reactors. These combinations include the in-situ coupling of micro-reactors with a microwave resonator, an X-ray diffractometer, an ESR and an IR spectrometer, the on-line and off-line coupling of micro-reactors with various surface analysis techniques (AES, ESCA, SIMS), as well as SEM and TEM investigations. Metal and oxide catalysts, e.g. for the oxidation of butene, naphtalene and methanol and for hydrogenation reactions, have been investigated in detail.

26513 **(DOE/ER/10980—3) Supported f-element complexes: surface chemistry and catalysis. Progress report, April 1, 1983-April 1, 1984.** Marks, T.J.; Burwell, R.L. Jr. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemistry). Apr 1984. Contract AC02-81ER10980. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011593.

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An accurate and reliable method for measuring the amount of CO adsorbed on organoactinide complex/alumina and the ensuing depression in catalytic activity for the hydrogenation of propylene has been developed. Several previously unexamined complexes deposited on dehydroxylated alumina have been studied. $Cp_2'Th(neopentyl)_2$ [Cp' = pentamethylcyclopentadienyl] leads to catalysts slightly more active for the hydrogenation of propylene at -63°C than $Cp_2'Th(CH_3)_2$. It is also active for the polymerization of ethylene at 25°C. $Cp'Th(benzyl)_3$ is considerably more active and ranks among the most active hydrogenation catalysts known. Coordinatively more saturated $Cp_3Th(n\text{-}butyl)$ and Cp_3UCH_3 lead to zero hydrogenation activity at -63 and 0°C, but to some activity at 100°C. Silica gel with 0.5 silanol groups per nm^2 does not lead to active catalysts. Both optical (f-f transitions) and high resolution solid state nmr spectroscopy have been used to characterize the structures of the adsorbed molecules.

26514 **(DOE/PC/30187—T1) Correlation of zeolites Nul and ZSM-5 acid site strength with catalytic activity and selectivity. Final report.** Hayhurst, D.T. (Cleveland State Univ., OH (USA). Dept. of Chemical Engineering). 1984. Contract AC22-80PC30187. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84003147.

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The effect of various pretreatments on catalytic properties of medium pore size zeolites, namely Nu-1 and ZSM-5, was determined. A breakdown begins in the as synthesized Nu-1 structure at 520°C and the Nu-1 is essentially amorphous by 700°C. The acidity of different metal impregnated ZSM-5's were characterized by microgravimetric measurement of ammonia adsorbed onto the acid sites of the zeolite. The isosteric heats of adsorption were measured at very low ammonia coverage. The heat of adsorption of the ZSM-5 sample with no metal was as high as 160KJ $mole^{-1}$. The maximum heat of adsorption for the sample impregnated in acetone solution stayed as high as 160KJ $mole^{-1}$ and dropped to 120KJ $mole^{-1}$ for the sample impregnated in water solution. Also the maximum heat of adsorption for the samples impregnated with cobalt and thorium in acetone and water solution dropped from 170KJ $mole^{-1}$ correspondingly to 145KJ $mole^{-1}$ and 134KJ $mole^{-1}$. Total numbers of acid sites decreased upon metal impregnation. 50 references, 26 figures, 15 tables.

26515 **(DOE/PC/50796—T5) Diffusion of gases in porous solids: simulations and measurements. Seventh quarterly report, January 16-April 15, 1984.** Evans, J.W. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Apr 1984. Contract FG22-82PC50796. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010822.

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The diffusion of a gas in a porous solid is analogous to two other classical problems: the conduction of heat in a two phase medium, one phase being insulating, and the conduction of electricity in a two phase medium one phase of which does not conduct. An example of the latter would be the problem of predicting the resistance of an electrolyte containing gas bubbles given the resistiviy of the electrolyte alone and information on the gas bubbles. This problem has been examined theoretically by both Maxwell and Bruggeman who provided equations that predict the variation of the effective resistivity (or its inverse, the effective conductivity) versus the volume fraction of bubbles. This analogy appears to have been left unrecognized and unexploited by investigators concerned with predicting diffusion rates in porous soldis. It enables the prediction to be made using the Maxwell or Bruggeman equations. Conversely the Monte Carlo simulations of gaseous diffusion in porous solids being carried out at Berkeley should yield predictions of the effective conductivity of electrolytes containing gas bubbles. Some results from the new algorithm for predicting gaseous diffusion rates discussed in the last quarterly report are compared to the predictions of the Bruggeman and Maxwell equations. Clearly the predictions of the Monte Carlo simulations agree with the classical equations. It has become apparent that the Monte Carlo simulations will provide spin offs in other important areas of transport phenomena, besides those of diffusion in porous solids.

26516 **(EUR—8275) Characterization and determination of the stability constant of lanthanide complexes with carbonates. Final report.** Bidoglio, G.; Marcandalli, B. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 97p. (In Italian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84700908.

The stability constants of Europium (III) complexes with carbonate and bicarbonate ions are measured at 22°C and at 0.5M ionic strength. Solvent extraction with 1.3-diphenyl 1.3-propanedione $5x10^{-2}$M in benzene is studied. The distribution between the organic and aqueous phases is determined by radioactive tracers. The limits of the spectrophotometric method and of the solubility in the evaluation of this type of complex are evidenced, mainly in the concentration range useful in geochemistry. Some results obtained with Nd and Am 241 are also given.

26517 **Theoretical study of deuterium isotope effects in the reactions $H_2 + CH_3$ and $H + CH_4$.** Schatz, G.C.; Wagner, A.F.; Dunning, T.H. Jr. (Argonne National Lab., IL). *Journal of Physical Chemistry;* **88**: No. 2, 221-232(19 Jan 1984). Contract W-31-109-ENG-38.

This paper presents ab initio potential surface parameters and transition state theory (TST) rate constants for the reaction $H_2 + CH_3 \rightarrow H + CH_4$, its reverse, and all the deuterium isotopic counterparts associated with it and its reverse. The potential surface parameters are derived from accurate POLCI calculations and include vibrational frequencies, moments of inertia, and other quantities for CH_3, H_2, CH_4, and the H-H-CH_3 saddle point. TST rate constants are calculated from standard expressions and the Wigner tunneling

correction. For $H_2 + CH_3$ and $H_2 + CD_3$, agreement of the rate constant with experiment is good over a broad temperature range, suggesting that the calculated 10.7 kcal/mol barrier is accurate to within about 0.5 kcal/mol barrier. Agreement with experiment for $H + CH_4$ using the calculated 13.5 kcal/mol reverse reaction barrier is poorer; a 12.5 kcal/mol barrier is found to provide a more reasonable estimate of the true barrier. The analysis of isotope effects in the $H + CH_4$ reaction is restricted to examining the branching ratios between H and D atom abstraction in the reaction of H with the mixed species CH_3D, CH_2D_2, and CHD_3. A combination of reaction path multiplicity, favorable zero point energy shifts, and a greater likelihood of tunneling causes H atom abstraction to predominate over D atom abstraction in $H + CH_3D$ and $H + CH_2D_2$, but for $H + CHD_3$, it was found that the H atom and D atom abstraction rate constants cross near 700 K, with H atom abstraction dominating at low temperatures and D atom at high. 9 figures, 7 tables.

26518 Absolute hardness: companion parameter to absolute electronegativity. Parr, R.G.; Pearson, R.G. (Univ. of North Carolina, Chapel Hill). *Journal of the American Chemical Society;* **105**: No. 26, 7512-7516(28 Dec 1983). Contract AM03-76SF00034.

For neutral and charged species, atomic and molecular, a property called absolute hardness eta is defined. Let E(N) be a ground-state electronic energy as a function of the number of electrons N. As is well-known, the derivative of E(N) with respect to N, keeping nuclear charges Z fixed, is the chemical potential μ or the negative of the absolute electronegativity chi: $\mu = (\delta E/\delta N)/$ sub Z/ = ¯chi. The corresponding second derivative is hardness: 2eta = $(\delta\mu/\delta N)$/sub Z/ = $(\delta chi/\delta N)$/sub Z/ = $(\delta^2 E/\delta N^2)$/sub Z/. Operational definitions of chi and eta are provided by the finite difference formulas (the first due to Mulliken) chi = 1/2(I+A), eta = 1/2(I-A), where I and A are the ionization potential and electron affinity of the species in question. Softness is the opposite of hardness: a low value of eta means high softness. The principle of hard and soft acids and bases is derived theoretically by making use of the hypothesis that extra stability attends bonding of A to B when the ionization potentials of A and B in the molecule (after charge transfer) are the same. For bases B, hardness is identified as the hardness of the species B^+. Tables of absolute hardness are given for a number of free atoms, Lewis acids, and Lewis bases, and the values are found to agree well with chemical facts. 1 figure, 3 tables.

26519 Photoionization study of $(H_2S)_2$ and $(H_2S)_3$. Prest, H.F.; Tzeng, W.B.; Brom, J.M. Jr.; Ng, C.Y. (Ames Lab., IA). *Journal of the American Chemical Society;* **105**: No. 26, 7531-7536(28 Dec 1983). Contract W-7405-ENG-82.

The internal effects and the energetics of the ion-molecule reactions $H_3S^+ + H_2S \rightarrow S_2^+ + 2H_2$, $HS_2^+ + H_2 + H$, $H_3S^+ +$ HS, and $H_3S_2^+ + H$ have been studied by photoionization of hydrogen sulfide dimers synthesized by the molecular beam method. The appearance energy (AE) for H_3S^+ from $(H_2S)_2$ was determined to be 10.249+/-0.012 eV (1209.7+/-1.5). This value allows the calculation of the absolute proton affinity for H_2S at 0 K to be 167.2+/-1.4 kcal/mol. By use of the measured ionization energies for $(H_2S)_2^+$ (9.596+/-0.022eV) and $(H_2S)_3^+$ (9.467+/-0.022eV) and the estimated bonding energies for $H_2S.H^2S$ and $(H_2S)_2.H_2S$(0.05 eV), the bond dissociation energies for $H_3S^+.H_2S$ and $(H_2S)_2^+.H_2S$ are deduced to be 0.92+/-0.04 and 0.18+/-0.04 eV, respectively. The AE for $H_3S^+.H_2S$ from $(H_2S)_3$ (9.84+/-0.04eV) also makes possible the calculation of the bond dissociation energy for $H_3S^+.H_2S$ to be 0.46+/-0.10 eV. 7 figures, 1 table.

26520 Thermochemical splitting of sulfur dioxide with cerium (IV) oxide. Peterson, E.J.; Foltyn, E.M.; Onstott, E.I. (Los Alamos National Lab., NM). *Journal of the American Chemical Society;* **105**: No. 26, 7572-7573(28 Dec 1983).

$Ce_2(SO_3)_2SO_4.4H_2O$ thermally decomposes in several steps to yield H_2O, sulfur, SO_2, and O_2 as gaseous products, plus $Ce_2O(SO_4)_2$, $Ce_2O_2SO_4$, $CeOSO_4$, and CeO_2 as intermediate products. The terminal solid product above 1250 K is CeO_2. Reaction pathways are described in detail. A thermochemical cycle for splitting SO_2 into sulfur and oxygen with CeO_2 is described, in which sulfur and/or oxygen and/or cerium all change valence in four different reactions.

26521 Aggregation of sulfosuccinate surfactants in water. Magid, L.J.; Daus, K.A.; Butler, P.D.; Quincy, R.B. (Univ. of Tennessee, Knoxville). *Journal of Physical Chemistry;* **87**: No. 26, 5472-5478(22 Dec 1983). Contract W-7405-ENG-26.

The aggregation of sodium di-n-alkyl sulfosuccinates in water (H_2O and D_2O at 45°C) has been investigated. A self-consistent picture of the dependence of sodium ion binding on surfactant concentration is obtained from emf measurements, conductimetry, and small-angle neutron scattering (SANS) measurements. The concentration dependence of the micellar agregation number for the sulfosuccinates and related double-tailed surfactants depends markedly on surfactant solubility. A sphere-to-disk transition in micellar shape, which might have been expected as a precursor to formation of a lamellar mesophase, was not observed as the surfactant concentration was increased. 8 figures, 2 tables.

26522 Silicon-29 nuclear magnetic resonance study of hydroxyl sites on dehydrated silica gel surfaces, using silylation as a probe. Sindorf, D.W.; Maciel, G.E. (Colorado State Univ., Fort Collins). *Journal of Physical Chemistry;* **87**: No. 26, 5516-5521(22 Dec 1983). Contract AS20-81LC10652.

A detailed ^{29}Si NMR analysis is presented on the silylation of a series of heat-treated silica gels by hexamethyldisilizane (HMDS) with the aim of elucidating details of the surface hydroxyl population of the unsilylated samples. It is found that the complete removal of all silanol groups from silica is probably approached only at temperatures higher than those normally employed in silica treatment (i.e., higher than 1000°C) and that some molecular water may remain on the surfaces of samples normally considered "dried" (e.g., evacuated at 200°C). The population and reactivity patterns of surface hydroxyls are considered in terms of reasonable surface and dehydration models.

26523 Transmission of magnetic interactions in a molecular metal oxide cluster. Siedle, A.R. (3M Central Research Laboratories, St. Paul, MN); Padula, F.; Baranowski, J.; Goldstein, C.; DeAngelo, M.; Kokoszka, G.F.; Azevedo, L.; Venturini, E.L. *Journal of the American Chemical Society;* **105**: No. 25, 7447-7448(14 Dec 1983). Contract AC04-76DP00789.

Reported is the characterization by PMR spectroscopy and magnetic susceptibility measurements of metal oxide mediated spin exchange in $W_{18}As_2O_{66}Cu_3(H_2O)_2^{12-}$, a polymetallic cluster. PMR spectra obtained at 9 GHz and 63 GHz indicate that a copper trimer is situated in an environment having essentially axial symmetry. The effective molar values obtained, g(m)perpendicular to = 2.075 and g (m) parallel to = 2.411, lead to the conclusion that the unpaired electrons reside primarily in 3d/sub x/ 2/sub-y/ 2 orbitals. Magnetic susceptibility data measured from 4 to 300 k were fitted to a mathematical expression suitable for an exchange-coupled trimer with 3 equivmagnetic centers to yield a value for the exchange interaction J. The importance of J and spin-exchange interactions is uncertain.

26524 Catalysis using hydrous metal oxide ion exchangers. Dosch, R.G.; Stephens, H.P.; Stohl, F.V. (to Dept. of Energy). US Patent Application 6-515,844. 21 Jul 1983. 25p. Contract AC04-76DP00789.

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In a process which is catalyzed by a catalyst comprising an active metal on a carrier, said metal being active as a catalyst for the process, an improvement is provided wherein the catalyst is a hydrous, alkali metal or alkaline earth metal titanate, zirconate, niobate or tantalate wherein alkali or alkaline earth metal cations have been exchanged with a catalytically effective amount of cations of said metal.

26525 Water dimer: theory versus experiment. Newton, M.D.; Kestner, N.R. (Brookhaven National Lab., Upton, NY). *Chemical Physics Letters;* **94**: No. 2, 198-201(14 Jan 1983). Contract AS05-77ER05399.

Equilibrium O...O separations (r/sub e/) and bond energies (D/sub e/) are calculated for the water dimer, with electron correlation included at the Moeller-Plesset (MP2 or MP3) level. Inclusion of corrections for basis set superposition error allows the ex-

perimental data for r/sub e/ and D/sub e/ to be bracketed. The r/sub e/ for the dimer is significantly larger than the mean O...O distance in liquid water. 1 table.

26526 **One-electron transfer equilibria and kinetics of N-methylphenothiazine in micellar systems.** Minero, C. (Univ. di Torino, Italy); Pramauro, E.; Pelizzetti, E.; Meisel, D. *Journal of Physical Chemistry;* **87**: 399-407(1983). Contract W-31-109-ENG-38.

The kinetics and equilibria of electron transfer between N-methylphenolthiozine and aquoiron(III) or octacyanomolybdate(V) in the presence of various micellar-forming surfactants (CTAN, Triton, SDS) were investigated by using several spectrophotometric techniques. The presence of micelles strongly influences the equilibria and the kinetics of the reactions. Binding constants are determined and electrostatic and hydrophobic effects in the various micellar systems are analyzed. 8 figures, 5 tables.

26527 **Temperature dependence of the magnetic susceptibility and proton and carbon-13 chemical shifts of tetramethylsilane.** Morin, F.G. (Univ. of Utah, Salt Lake City); Solum, M.S.; Withers, J.D.; Grant, D.M.; Dalling, D.K. *Journal of Magnetic Resonance;* **48**: 138-142(1982). Contract AC02-78ER05006.

The absolute temperature dependence of the TMS carbon resonance is determined and the results are reported. These experiments also determined the absolute temperature dependence of the bulk susceptibility of TMS and the results are used to correct the previously reported temperature dependence of the TMS proton resonance.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 25215, 26486, 26497, 26514, 26521, 26526, 26551, 26553, 26554, 26569, 26998, 27152

26528 (ANL—83-55, pp 138-168) **Basic energy science.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The Basic Energy Science Program involves efforts in (1) fluid catalysis, (2) physical and environmental chemistry, and (3) thermodynamics and electrochemistry.

26529 (LBL—13500, pp 1.31-1.33) **Homogeneous catalytic hydrogenations of models synthetic fuel compounds.** Fish, R.H.; Cremer, G.A.; Vermeulen, T.; Thormodsen, A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

26530 **Preparation and spectral electrochemical characterization of dirhodium(II) complexes with bridging 1,8-naphthyridine ligands. X-ray crystal structure of tris(μ-acetato)(2,7-bis(2-pyridyl)-1,8-naphthyridine) dirhodium(II) hexafluorophosphate.** Tikkanen, W.R.; Binamira-Soriaga, E.; Kaska, W.C.; Ford, P.C. (Univ. of California, Santa Barbara). *Inorganic Chemistry;* **23**: No. 2, 141-146(18 Jan 1984).

The preparations and spectral and electrochemical characterizations of several dirhodium(II) complexes of substituted 1,8-naphthyridines are described. These dinuclear complexes are derived by reaction of the appropriate polydentate 1,8-naphthyridine species with dirhodium tetraacetate. The monosubstituted derivatives $Rh_2(O_2CCH_3)_3L^+$ include complexes of the crescent-shaped ligand (L) 2,7-bis(2-pyridyl)-1,8-naphthyridine (bpnp) and of 5,6-dihydrodipyrido[2,3-b:3',2'-j]-[1,10]phenanthroline (dinp) and 2-(2-pyridyl)-1,8-naphthyridine (pynp). A disubstituted complex, $Rh_2(O_2CCH_3)_2(pynp)_2^{2+}$, and a tetrasubstituted derivative, $[Rh_2(np)_4]Cl_4$ (np = 1,8-naphthyridine), are also described. Each of these compounds displays electronic spectral bands in the visible region that have been assigned as metal to ligand charge-transfer absorptions not seen in the parent tetraacetate. The electrochemical properties as studied by cyclic voltammetry also differ significantly from those of the tetraacetate with the mono- and disubstituted derivatives displaying both reversible oxidations and reduction. The spectral properties of these complexes are discussed in terms of their probable structures. The structure of the bpnp adduct, $[Rh_2(O_2CCH_3)_3bpnp]PF_6$, has been determined by X-ray diffraction techniques and refined by full-matrix least-squares procedures to a final R index of 0.068. Crystals are tetragonal, space group $I4_1cd$, with cell dimensions a = b = 28.720 (14) A, c = 13.906 (5) A, and V = 11470 (9) A^3 and with Z = 16. The two rhodium atoms are bridged by three acetate groups and the naphthyridine fragment bpnp. The 2-pyridyl nitrogen atoms occupy the axial sites trans to the Rh-Rh bond (Rh-Rh distance = 2.405 (2) A). 2 figures, 8 tables.

26531 **Reactions of group 8 transition-metal ions (Fe^+, Co^+, and Ni^+) with cyclic hydrocarbons in the gas phase.** Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **105**: No. 26, 7492-7500(28 Dec 1983). Contract AC02-80ER10689.

The gas-phase reactions of group 8 transition-metal ion (Fe^+, Co^+, and Ni^+) with cyclic hydrocarbons were studied by Fourier transform mass spectrometry. Product structures were probed by using collision-induced dissociation (CID) and H/D exchanges. All three metal ions react with cyclobutane to generate ring-cleavage products exclusively. This is in contrast to reactions with cyclopentane and cyclohexane, where dehydrogenation dominates, producing cycloalkene- and cycloalkadiene-metal ion complexes. Bis(ethene)- metal ion complexes formed in secondary reactions, are shown not to be in equilibrium with metallacyclopentanes. Metallacyclopentanes decompose by symmetric ring cleavage, producing an ethene-metal ion complex, or by an initial 1,3-hydrogen shift, producing a linear butene complex which dehydrogenates, forming a butadiene-metal ion complex. Both Fe-c-$C_6H_6^+$ undergo six H/D exchanges with D_2. The rate constant for the first exchange is found to be about an order of magnitude faster than for the second exchange. Cycloalkadiene products of Fe^+ and Co^+ react rapidly with their corresponding cyclic-alkane analogues exclusively by multiple dehydrogenations. Cycloalkadiene products of Ni^+, however, were found to be unreactive with cyclic alkanes. 5 figures, 3 tables.

26532 **Synthesis of molybdenum-rhodium and molybdenum-iridium compounds linked by a heterodifunctional ligand and formation of molybdenum-iridiumdihydrides by reaction with molecular hydrogen.** Casey, C.P.; Bullock, R.M.; Nief, F. (Univ. of Wisconsin, Madison). *Journal of the American Chemical Society;* **105**: No. 26, 7574-7580(28 Dec 1983).

The preparation of a series of Rh(i)-Mo and Ir(I)-Mo compounds is reported. In addition, the formation of dihydrides from the oxidative addition of H_2 to the Ir(I) centers is discussed.

26533 **Resonance Raman and molecular orbital studies of the effects of deuteration on the vibrational structure of the p-benzosemiquinone radical anion.** Schuler, R.H.; Tripathi, G.N.R.; Prebenda, M.F.; Chipman, D.M. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **87**: No. 26, 5357-5361(22 Dec 1983).

Deuterium substitution of the p-benzosemiquinone radical anion results in decreases of 23 and 317 cm^{-1} in the vibrational frequencies of its totally symmetric ring stretching (Wilson 8a) and C-H bending (9a) modes as observed by resonance-enhanced Raman methods. Ab initio molecular orbital calculations corroborate the vibrational assignments and predict decreases of a similar magnitude. Both the experimental and theoretical studies show that the bands associated with the CO stretching and C-C-C bending vibrations are affected to only a very minor extent by deuteration, i.e., that there is very little contribution from local modes involving hydrogen motion. The symmetrical ring breathing (1) and C-H stretching (2) modes are not resonance enhanced and not observed in the Raman experiments. Of particular note is the Raman band at the ring stretching frequency of the deuterated radical which is considerably broader than the other lines in H_2O and partially resolved into two lines in D_2O. This feature is tentatively interpreted as being due to an accidental near degeneracy with the combination of the 9a and 1 modes. Deuteration of the radical somewhat simplifies its optical absorption spectrum in the region of 400-410 nm in-

dicating that the frequency of the 9a vibration in the excited state is decreased in much the same way as in ground state.

26534 Intramolecular photochemical electron transfer. Fluorescence studies of linked porphyrin-quinone compounds. Siemiarczuk, A.; McIntosh, A.R.; Ho, T.F.; Stillman, M.J.; Roach, K.J.; Weedon, A.C.; Bolton, J.R.; Connolly, J.S. (Univ. of Western Ontario, London). *Journal of the American Chemical Society;* **105**: No. 25, 7224-7230(14 Dec 1983). Contract AC02-77CH00178.

Systematic studies of absorption spectra and fluorescence spectra and lifetimes have been carried out on a series of meso-tetratolylporphyrins to which various molecular entities have been covalently attached via diamide linkages with the two amides being separated by n methylene groups (n=2, 3, or 4). The attached end groups include p-benzoquinone, hydroquinone, and dimethoxybenzene. These studies reveal the existence of at least two more or less distinct forms: a family of "complexed" conformers in which the end group is likely folded so as to interact with the porphyrin, and one or more "extended" conformers in which the porphyrin moiety is relatively unperturbed by the end group. The complexed conformers exhibit perturbations of spectra and diminished fluorescence lifetimes and quantum yields as compared with the extended conformer(s). Oxidation of the porphyrin-linked hydroquinone form to the quinone form does not significantly affect the absorption or fluorescence spectra but causes strong quenching of fluorescence and diminution of the fluorescence lifetimes. This quenching is interpreted primarily in terms of electron transfer from the lowest excited singlet state of the porphyrin to the quinone moiety. On the basis of the assumption that these shorter fluorescence lifetimes of the quinone relative to the hydroquinone are due entirely to electron transfer, apparent electron-transfer rate constants k/sup et/ at room temperature range from $<1 \times 10^8$ to $<7 \times 10^9$ s^{-1}, depending on solvent and probably the specific geometry of the conformers. Quenching in both sets of conformers appears to be thermally activated and is strongly inhibited in frozen matrices. Parallel studies of porphyrin-quinone molecules with various methylene chains (n=2, 3, and 4) indicate that the geometry of the linkage is critical to the rate of electron transfer. A methylene chain with n = 3 appears to be optimum. 4 figures, 6 tables.

26535 Reaction of fluorine atoms with alkyl iodides: a possible observation of the Walden inversion in the gas phase. Venkitachalam, T.V.; Das, P.; Bersohn, R. (Columbia Univ., New York, NY). *Journal of the American Chemical Society;* **105**: No. 25, 7452-7453(14 Dec 1983).

Evidence is presented to show that The Walden Inversion does take place in these gaseous reactions. CO_2 laser radiation of a mixture of SF_6 and alkyl iodides at equal pressures dissociated the SF^6 to F and SF^5. One μs later, the alkyl iodides were dissociated by a pulse from a dye laser. The experiment was repeated at 5 Hz. The resulting fluorescence intensities at 304.7 nm and 306.7 nm for I/sup */ atoms and excited I atoms are shown for methyl, ethyl, isopropyl, and tert-butyl iodide. From the relative intensities produced, conclusions can be drawn that a tertiary iodide does not produce any iodine atoms, while a primary iodide produces many more. Tests were performed to show that the iodine atoms were not photodissociated from the alkyl iodide cy the CO_2 laser or by 2-photon dissociation by the dye laser of the radical products of competing reactions. In the absence of SF_6, CO_2 laser pulses did not produce additional I atoms. 1 figure.

26536 Hydrogen bond breaking by oxygen and nitrogen. Mathers, T.L.; Schoffler, G.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge). *Journal of Physical Chemistry;* **87**: No. 22, 4355-4357(27 Oct 1983).

The temperature dependency of the phosphorescence properties of aromatic hydrocarbons in alcoholic glasses exhibits a number of phenomena that have not been previously described. Chief among these are the effects of added gases (O_2, N_2, C_2H_6, Ar, etc.), some of which produce major changes in the luminescence characteristics. These are discussed, and rationalized in terms of a model which presumes that O_2 and N_2 disrupt the normal hydrogen bonding process between alcohol molecules. 1 figure.

26537 Ultraviolet light absorbers having two different chromophors in the same molecule. Vogl, O.; Li, S. (to Dept. of Energy). US Patent Application 6-539,366. 6 Oct 1983. 15p. Contract AI01-76ET20356.

Portions are illegible in microfiche products.

This invention relates to novel ultraviolet light absorbers having two chromophors in the same molecule, and more particularly to benzotriazole substituted dihydroxybenzophenones and acetophenones. More particularly, this invention relates to 3,5-[di(2H-benzotriazole-2-yl)]-2,4-dihydroxybenzophenone and 3,5-[di(2H-benzotriazole-2-yl)]-2,4-dihydroxyacetophenone which are particularly useful as an ultraviolet light absorbers.

26538 Di- and tri-benzotriazole substituted tri-hydroxybenzenes. Vogl, O.; Li, S. (to Dept. of Energy). US Patent Application 6-539,493. 6 Oct 1983. 11p. Contract AI01-76ET20356.

Ultraviolet light stabilizing compounds of the formula (phenyl) R_1, $R_3(OH)_3R_3$, are described, wherein R_1, R_2, and R_3 are hydrogen or 2H-benzotriazole-2-yl groups and wherein no more than one of R_1, R_2, and R_3 is hydrogen, and organic compositions susceptible to ultraviolet light degradation containing these compounds, and method for selectively producing the compounds.

26539 Process for the preparation of benozotriazoles and their polymers, and 2(2-hydroxy-5-isopropenylphenyl)2H-benzotriazole produced thereby. Vogl, O.; Nir, Z. (to Dept. of Energy). US Patent Application 6-537,219. 29 Sep 1983. 19p. Contract AI01-76ET20356.

Portions are illegible in microfiche products.

This invention relates to a process for the production of substituted benzotriazoles, particularly for the production of such substituted benzotriazoles which are useful as polymerizable ultraviolet light absorbers. The invention also relates to a new benzotriazole, 2(2-hydroxy-5-isopropenylphenyl)2H-benzotriazole, which is polymerizable ultraviolet light absorber, and its preparation, and to the preparation of 2(2-hydroxy-5-vinylphenyl)2H-benzotriazole, another polymerizable ultraviolet light absorber.

26540 Phase compositions of aqueous/hydrocarbon systems containing organic salts, alcohol, and sodium chloride. Ho, P.C.; Bender, T.M. (Oak Ridge National Lab., TN). *Journal of Physical Chemistry;* **87**: No. 14, 2614-2620(1983). Contract W-7405-ENG-26.

The phase compositions of five-component systems containing n-octane, water, 1-butanol, sodium chloride, and one of two low-equivalent-weight organic salts (protosurfactants) have been analyzed. The organic salts are sodium 2,5-diisopropylbenzenesulfonate or sodium 3,5-diisopropylsalicylate, both of which have six alkyl carbons on side chains of the benzene ring. The similarities earlier observed in phase behavior of protosurfactant systems and surfactant systems are extended in these results. The distribution of organic salts between phases with changes in composition follows the trends known for surfactants. Sodium chloride is concentrated in the lower phase, but significant amounts are found in the middle phase in three-phase systems. In the middle range of salinity and alcohol concentrations, at the onset of occurrence of three phases, the ratio of water to oil in the middle phase decreases as the salinity or alcohol concentration increases. The ratios of activity coefficients of sodium chloride in the middle phase to those in the aqueous phase are rather constant, and close to 1 despite the large differences in the media between the middle and bottom phases. However, the ratios of formal activity coefficients of these two protosurfactants in the middle phase to those in the aqueous phase are very small; the low activity coefficients of protosurfactants in the protosurfactant-rich phase suggest differences in aggregation in the two phases. 23 references, 4 figures, 6 tables.

26541 Preparation and reactions of porphyrin n-oxides. Andrews, L.E. (Queen Mary Coll., London, England); Bonnett, R.; Ridge, R.J.; Appelman, E.H. *Journal of the Chemical Society, Perkin Transactions 1: Organic and Bio-Organic Chemistry;* **1**: 103-107(1983).

The reaction of octaethylporphyrin with hypofluorous acid and with permaleic acid gives a mono-oxygen adduct formulated as

the porphyrin N-oxide, a novel chemical system. Octaethylporphyrin N-oxide is a sensitive molecule: it is gradually converted into octaethylporphyrin when manipulated under ordinary conditions. Examples of deoxygenation, nucleophilic attack at C-5, and metal complexation are described.

26542 **Hydroxide-catalyzed synthesis of heterocyclic aromatic amine derivatives from nitriles.** Smyrl, N.R.; Smithwick, R.W. III. (Oak Ridge Y-12 Plant, TN). *Journal of Heterocyclic Chemistry;* **19**: 493-496(May-Jun 1982). Contract W-7405-ENG-26.

A generalized method for synthesizing a wide variety of heterocyclic aromatic amine derivatives from nitriles by use of hydroxide catalysts is presented. Nitrile dimers (3-aminocrotononitrile and dicyandiamide) and a dimer analog (anthranilonitrile) react with monomeric nitriles in the presence of hydroxide to form respectively, aminopyrimidines, diaminotriazines and aminoquinazolines.

26543 **Thermal conductivity of mixtures of methane with carbon dioxide.** Kestin, J. (Brown Univ., Providence, RI); Ro, S.T.; Nagasaka, Y. *Berichte der Bunsengesellschaft fuer Physikalische Chemie;* **86**: 945-948(1982). Contract AC02-81ER10811.

The paper is an addendum to two previous papers which contained data on the thermal conductivity of the systems H_2-N_2 and N_2-CH_4. The present system is CH_4-CO_2, thus forming a natural progression in the complexity of the molecular structure of the set of binary systems under investigation. The system chosen for study is still characterized by nearly spherical intermolecular force potentials. The results extrapolated to zero density show excellent agreement with the Monchick-Pereira-Mason theory and continue to demonstrate that the inelastic-collision term is small (~ 1%), thus asserting that the Hirschfelder-Eucken approximation is acceptable. At higher densities, the version of the Thorne-Enskog theory due to Mason et al. gives a systematic deviation of only -2% over the whole composition range.

26544 **Concentration-dependent transport of gases and vapors in glassy polymers. II. Organic vapors in ethyl cellulose.** Saxena, V.; Stern, S.A. (Syracuse Univ. NY). *Journal of Membrane Science;* **12**: 65-85(1982).

The solution (sorption) and transport of acetone, benzene, and methanol vapors in ethyl cellulose have been studied by Barrer, Barrie and Slater [J. Polymer Science, 23 (1957) 331] over a range of temperatures and penetrant concentrations. The solubility isotherms for the three penetrants as well as the diffusivity and permeability data for acetone reported by these investigators are analyzed in terms of a dual-sorption model with partial penetrant immobilization, assuming that the diffusion coefficient is concentration dependent. 18 references, 13 figures, 3 tables.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 26491, 26530, 26555

26545 **Electrocatalytic oxidation of carbon monoxide in a CO/O_2 fuel cell.** Wu, J.; Kubiak, C.P. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **105**: No. 25, 7456-7457(14 Dec 1983).

Evidence is presented to show that $[Rh(CO)_2Br_2]$ is a suitable electrocatalyst for the oxidation of CO to CO_2 and that fuel cells based on homogeneous electrocatalysis can be constructed. The design and output characteristics of prototypical fuel cells are described. Homogeneous electrocatalysts offer the ability to function effectively at relatively low temperatures and may find apllication in fuel cell research. 3 figures.

26546 **Optically transparent porous metal foam electrode.** Hobart, D.E. (Univ. of Tennessee, Knoxville); Norvell, V.E.; Varlashkin, P.G.; Hellwege, H.E.; Peterson, J.R. *Analytical Chemistry;* **55**: No. 9, 1634-1637(Aug 1983).

The development of porous metal foam has made possible the construction of a porous metal foam optically transparent electrode (PMF-OTE). PMF is similar to reticulated vitreous carbon in its structure and optical properites. The fabrication and evaluation of PMF for use as an OTE are presented.

26547 **Arsenic and platinum deposition during cathodic hydrogenation.** Lewis, M.B.; Farrell, K. (Oak Ridge National Lab., TN). *Scripta Metallurgica;* **17**: No. 3, 365-369(1983). Contract W-7405-ENG-26.

These experiments show that arsenic promoter and supposedly inert platinum anode material are co-deposited with hydrogen on the cathode surface during cathodic hydrogenation. The arsenic is initially deposited faster than the platinum, thus accelerating the deposition of platinum. Hydrogen (deuterium) uptake by the cathode appears to increase to a high saturation level as the amount of metal deposited reaches the equivalent of a monolayer or more of surface coverage. The presence of these deposits should be considered in hydrogen embrittlement tests made under dynamic cathodic electrolysis. 3 figures, 1 table.

4005 Photochemistry

REFER ALSO TO CITATION(S) 26519, 26534, 26535, 26560, 26571

26548 (BNL—51714, pp 65-67) **Time-resolved studies of free radicals and laser-initiated chain reactions.** Leone, S.R. (Univ. of Colorado, Boulder). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

26549 **(DOE/ER/10660—T2) Multiphoton ionization spectroscopy and photochemistry of transient species. Technical progress report.** Johnson, P.M. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry). Mar 1984. Contract AC02-80ER10660. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010424.

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A technique was developed for the production of cold triplets and radicals in sufficient densities to allow multiphoton ionization and other types of skimmed beam experiments using pulsed valves. The occurrence of the discharge outside the valve permits the production of species which are sensitive to collisional quenching because soon after production the expansion eliminates further interaction of reactive species. The crux of the technique lies in the development of a suitable pulsed electric discharge. Some of the problems overcome in the development of this technique included arcing between the electrodes and jitter in the onset of the discharge. Triplet argon, triplet CO and CCL radical, were used to demonstrate this technique.

26550 **Solution medium control of the photoredox yield in the $Ru(bpy)_32i$/methyl viologen/EDTA system.** Mandal, K.; Hoffman, M.Z. (Boston Univ., MA). *Journal of Physical Chemistry;* **88**: No. 2, 185-187(19 Jan 1984).

The observed quantum yield of formation of the methyl viologen radical cation, phi(MV^+-), upon 450-nm irradiation of the $Ru(bpy)_3^{2+}$/methyl viologen dication/EDTA system at pH 11.0 is dependent on the concentrations of all three components. Under the conditions of the experiments, phi(MV^+-)≈2eta/sub cr/ where eta/sub cr/ is the efficiency of release of redox products from the solvent cage. The maximum value of eta/sub cr/ is ≈0.17 at high concentrations of all components where the photosensitizer, electron relay, and sacrificial electron donor exist as ion-paired aggregates within a single solvent-caged unit. 3 figures.

26551 **Polarized nonvertical excited states: FORS MCSCF and CI study of torsion and bending in allene.** Lam, B.; Johnson, R.P. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **105**: No. 26, 7479-7483(28 Dec 1983). Contract W-7405-ENG-82.

Ab initio FORS (Full Optimized Reaction Space) MCSCF and CI (configuration interaction) calculations have been performed for low-lying electronic states of allene at planar geometries, and CI calculations have been performed along torsional and bending coordinates (D/sub 2d/ → D_2 → D/sub 2h/ → C/sub 2v/ → C_2 → D/sub 2d/). Excited-state minima which correlate with the 1^1B_1 state of allene are located at D/sub 2h/ and C/sub 2v/ geometries. These two nearly isoenergetic minima are strongly polarized, but in

opposite directions. Polarization is not "sudden" along the C_4 coordinate, but develops gradually through bending and twisting motions. Potential involvement of these polarized states in allene photoreactions is discussed.

26552 **Kinetics of the superoxide radical oxidation of[cobalt sepulchrate](2+). A flash photolytic study.** Bakac, A.; Espenson, J.H.; kCreaser, I.I.; Sargeson, A.M. (Ames Lab., IA). *Journal of the American Chemical Society;* **105**: No. 26, 7624-7628(28 Dec 1983). Contract W-7405-ENG-82.

The postulated formation of the superoxide radical anion, O_2^--, as an intermediate in the reaction of $Co(sep)^{2+}$ (sep = sepulchrate) with molecular oxygen has now been confirmed by a trapping reaction with Cu^{2+}. In the absence of Cu^{2+}, O_2^--oxidizes a second $Co(sep)^{2+}$ to $Co(sep)^{3+}$. The latter reaction, studied directly by use of the flash photolytic technique, has at 25°C a rate constant of (4.6+/-1.1) x $10^7 M^{-1}s^{-1}$, independent of pH in the range 11.3-12.6. Nitrogen perdeuteration yields $d(N)^{6+}$ $Co(sep)^{2+}$, which reacts with O_2 at the same rate but with O_2^- 2.1 times more slowly. The proposed mechanism of the O_2^- reaction consists of the hydrogen atom abstraction from a N-H bond of $Co(sep)^{2+}$ by O_2^-, followed by the rapid protonation of the products, Co/sup III/$(sep-H)^{2+}$ and HO_2, to form $Co(sep)^{3+}$ and H_2O_2. In contrast, the reaction between $Co(sep)^{2+}$ and O_2, which shows no kinetic isotope effect, occurs by outer-sphere electron transfer.

26553 **Photochemical transformation. 35. Stereochemistry of electron transfer from photoexcited aromatic rings to carbon-chlorine bonds. Syn stereochemistry of migration in photo-Wagner-Meerwein rearrangements.** Cristol, S.J.; Seapy, D.G.; Aeling, E.O. (Univ. of Colorado, Boulder). *Journal of the American Chemical Society;* **105**: No. 25, 7337-7345(14 Dec 1983). Contract AC02-79ER10366.

Studies have been conducted on the ground-state and excited-state solvolyses of the isomeric 7,8-dichloro derivatives of benzonaphthobicyclo[2.2.2]octadiene and benzoveratrobicyclo[2.2.2]octadiene. The silver ion assisted ground-state reactions proceed, as anticipated, with clean anti-stereochemistry (inversion at the migration terminus) reflected in the Wagner-Meerwein rearranged solvolysis products. Unlike the previously reported observations that excitation transfer from a photoexcited benzene ring to a β-carbon-chlorine bond requires anti-stereochemistry, electron transfer from excited naphthalene or veratrole rings occurs to both syn and anti carbon-chlorine bonds, although that to the latter is preferred. The results are consistent with an electron-transfer process to give a zwitterionic biradical and are rationalized by the Weller equation. Separation of chloride ion from the presumed zwitterionic biradical is accompanied by "Wagner-Meerwein" rearrangement but is predominately syn, rather than anti as in the ground state. The rearrangement stereochemistry is consistent with the idea that, in the principal photochemical process, migration with retention of configuration is concerted with the loss of chloride ion. 3 tables.

26554 **Quantum yield determinations for sub-nanosecond-lived excited states and photoproducts. Applications to inorganic complexes and photosynthetic models.** Bergkamp, M.A.; Chang, C.K.; Netzel, T.L. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **87**: No. 22, 4441-4446(27 Oct 1983). Contract AC02-76CH00016.

Presented is a procedure for determining the quantum yields of nonluminescent excited states and photoproducts with subnanosecond lifetimes. A procedure is described for calibrating the intensity of the photoexcitation pulse (einstein cm^{-2} $pulse^{-1}$) and a numerical calculation of percent excitation for an optically dense sample. Particular attention is paid to the case for which a large fraction of starting material is transformed into photoproduct, a common occurrence in picosecond absorption spectroscopy. The quantum yields of the lowest energy ligand-field excited state of $Fe(phen_3)^{2+}$ (phen = 1,10-phenanthroline) and the 200-ps-lived electron-transfer (ET) photoproduct (Mg^+-H_3^-) were determined in a diporphyrin model of photosystem II (PSII) to be 1.00 +/- 0.05 and 0.9 +/- 0.1, respectively. In both cases the observed photoproducts are formed from the decay of ultrashort-lived, initial excited states (tau < 10 ps). 4 figures.

26555 **Improvement of the photoelectrochemical oxidation of halides by platinization of metal dichalcogenide photoanodes.** Simon, R.A.; Ricco, A.J.; Harrison, D.J.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *Journal of Physical Chemistry;* **87**: No. 22, 4446-4453(27 Oct 1983).

Electrochemical deposition of Pt onto the surface of n-MoS_2 or n-WS_2 electrodes results in significant improvement in the efficiency of the photoelectrochemical oxidation of Cl^- or Br^- in aqueous or nonaqueous media. The optimum amount of Pt is in the 10^{-8}-10^{-7} mol/cm^2 range where electron microscopy and Auger and X-ray photoelectron spectroscopy show that the Pt incompletely covers the MS_2 surfaces. Phenomenologically, the deposited Pt behaves as a catalyst for the two-electron oxidation of X^- and does not affect the interfacial energetics of the n-MS_2/liquid electrolyte. Improvement in efficiency for X^- oxidation results from enhanced photovoltages and fill factors. Improvement in the oxidation of Cl^- in 15 M LiCl is most notable; for one n-MoS_2 electrode the platinization improved the energy conversion efficiency from 0.7% to 9.8% for 632.8 nm (36 mW/cm^2) and for one n-WS_2 electrode the efficiency was improved from 7.4% to 13.4% for 632.8 nm (15 mW/cm_2). The improved efficiency can be maintained at ~10 mA/cm^2 for periods of ~1 h, but the Pt catalyst is slowly oxidatively dissolved and the output eventually declines to that associated with naked n-MS_2 photoanodes. 4 figures, 2 tables.

26556 **Reactions of photoexcited triplet states of zinc porphyrin with transient radicals in aqueous solutions.** Neta, P. (Univ. of Notre Dame, IN); Levanon, H. *Israel Journal of Chemistry;* **22**: 107-111(1982).

The technique of simultaneous pulse radiolysis and photolysis, PRAP, has been utilized to study the reactions of various radicals with ground state zinc tetra(4-solfonatophenyl)porphyrin (ZnTPPS) and the triplet state ZnTPPS/sup T/ in aqueous solutions. The radicals H and OH add to both states with k ~ 1 x 10^{10} M^{-1} s^{-1}. The $CH_3C(CH_3)_2OH$ radical from t-BuOH is relatively inert toward ZnTPPS but reacts rapidly (k = 1.8 x 10^9 M^{-1} s^{-1}) with ZnTPPS/sup T/ to form an adduct. Electron transfer reactions are found to be about an order of magnitude faster with the triplet than with the ground state. The $(CH_3)_2COH$ radical reduces both ZnTPPS (k = 1 x 10^8 M^{-1} s^{-1}) and ZnTPPS/sup T/ (k = 3 x 10^9 M^{-1} s^{-1}) to the anion radical $(ZnTPPS)^-$. The radical Br_2^- oxidizes both states to the cation radical $(ZnTPPS)^+$ with k = 8 x 10^8 M^{-1} s^{-1} for the ground state and 5 x 10^9 M^{-1} s^{-1} for the triplet. The transient cation Cd^+ reduces both states with a diffusion-controlled rate (k = 1 x 10^{10} M^{-1} s^{-1}) to produce the anion radical. The above mechanisms of radical addition and electron transfer are also supported by the product spectra. 21 references, 7 figures, 1 table.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 26556

26557 (DL/SCI/R—19, pp 78-83) **SRS radiation induced polymerization of diacetylene monomers.** Dudley, M.; Sherwood, J.N. (Strathclyde Univ., Glasgow (UK)); Ando, D.J.; Bloor, D. (Queen Mary Coll., London (UK). Dept. of Physics). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

An assessment has been made of the defect structure in the single crystal diacetylene PTS both in the monomer and polymer form, using White Beam Radiation Topography. A one-to-one relationship was found between defects present in the monomer and subsequent polymer crystal. The strain induced during the polymerization process has also been recorded. This strain is seen to relax out when polymerization is complete, to leave a polymer crystal with the defect structure of the original monomer crystal 'frozen in'. It has been shown that the technique of White Beam Synchrotron Radiation Topography is an extremely useful and essential tool for studies of this nature.

26558 (DOE/ER/60159—1) Role of the local environment on the radiation chemistry of biological molecules: proline in single crystals. Progress report, July 15, 1983-July 14, 1984. Nelson, W.H. (Georgia State Univ., Atlanta (USA)). 1984. Contract AS05-83ER60159. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010803.

The objectives of this project are to fully explore the evidence for local environmental influence on the chemical transformations of radiation-initiated radical products in proline and related compounds. In the preliminary studies, described in the original proposal, it was found that products descended from the primary electron-adducts were present in all members of the group to be studied. However, at room temperature, little evidence was found for products which could have descended from the primary electron-abstraction ones. Accordingly, as described below, the major effort at this stage of the project has been to examine products stabilized at liquid helium temperatures (4.2K), in order to identify the electron-abstraction products prior to their major transformations.

26559 Comparison of electron magnetic resonance and x-ray studies of the structure of $VO(H_2O)_5^{2+}$. Kevan, L. (Univ. of Houston, TX). *Journal of Physical Chemistry;* **88**: No. 2, 327-328(19 Jan 1984).

Some structural parameters of $VO(H_2O)_5^{2+}$ determined by electron spin echo modulation (ESEM) in frozen solutions and by electron nuclear double resonance (ENDOR) in single crystals of the $Mg(NH_4)_2(SO_4)_2$-$6H_2O$ Tutton salt are different. It was determined that the single-crystal ENDOR results are consistent with powder INDOR results. X-ray results did not strictly correspond to the structure of $VO(H_2O)_5^{2+}$ but was a close approximation. The structure of $VO(H_2O)_5^{2+}$ was interpreted by all techiques as four equatorial waters in a plane perpendicular to the V=O bond and one axial water in the plane of the V=O bond with the axial water being more distant than the equatorial waters from V. V-O distances were determined directly in the x-ray studies. Comparison of the isotropic hyperfine coupling determined by single-crystal ENDOR with that determined by powder ESEM was included. Also the typical approach used in powder ESEM and ENDOR analyses were compared. 1 table.

26560 Mechanism of O^3P atom formation in γ-irradiated and UV photolyzed aqueous solutions. Hart, E.J.; Brown, W.G. (Argonne National Lab., IL (USA)); Bjergbakke, E. (Risoe National Lab., Roskilde (Denmark)). *Radiation Physics and Chemistry;* **23**: No. 1-2, 181-186(1984).

O^3P atoms form by excitation processes in the radiolysis and photolysis of the oxyhalate ions, BrO_3^- and ClO_4^-. However, the mechanism for O^3P formation by the radiolysis of dilute alkaline solutions involves non-excitation processes. Evidence for this conclusion is provided by a comparison of 'direct effect' calculations on these systems. They demonstrate that the relative yield of O^3P from OH^- is 15-fold greater than that of BrO_3^- thus indicating a more effective mechanism for O^3P formation in alkaline solutions. The expected increase in $G(H_2)$ from the postulated excitation decay reaction: $(OH^-)^* = O^3P + H^-$ followed by $H^- + H_2O = H_2 + OH^-$ could not be confirmed. Neither water nor OH^- produce O^3P when irradiated at 184.9 nm. However relatively high yields of O^3P form in alkaline H_2O_2 solutions photolyzed at 253.7 nm. A possible reaction is: $O^- + OH = O^3P + OH^-$. The participation of sub-excitation electrons in aqueous radiolytic excitation phenomena is further explored in the radiolysis of formate solutions.

26561 Mechanisms of the dismutation of superoxide catalyzed by the copper(II) phenanthroline complex and of the oxidation of the copper(I) phenanthroline complex by oxygen in aqueous solution. Goldstein, S.; Czapski G. (Hebrew Univ. of Jerusalem, Israel). *Journal of the American Chemical Society;* **105**: No. 25, 7276-7280(14 Dec 1983). Contract AC02-76EV03221.

The technique of pulse radiolysis to generate O^-_2 has been used to demonstrate that copper 1,10-phenanthroline ($(op)_2Cu^{2+}$)is capable of catalytically dismutating O^-_2 with a "turnover" rate constant k/sub cat./ = (5.1+/-0.9) x 10^8 $M^{-1}s^{-1}$. The rate constants of the reduction of $(op)_2Cu^{2+}$ and of the oxidation of $(op)_2Cu^+$ by O^-_2 have been determined to be (1.93+/-0.07) x 10^9 and (2.95 +/-0.3) x 10^8 $M^{-1}s^{-1}$, respectively. The kinetic results of the oxidation of $(op)_2Cu^+$ by molecular oxygen in aqueous solution are interpreted by a mechanism that proceeds via a superoxide intermediate, and the rate constant k/sub -10/ = (5.0 +/- 0.3) x 10^4 $M^{-1}s^{-1}$ has been determined. The rate constant of the oxidation of $(op)_2Cu^+$ by H_2O_2 was measured to be k_{32} = (937 +/- 20) $M^{-1}s^{-1}$. 7 figures.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 27151, 27152

26562 Quasirelativistic SCF-Xα scattered-wave study of uranocene, thorocene, and cerocene. Roesch, N.; Streitwieser, A. Jr. (Technical Univ. Munich, Garching, Germany). *Journal of the American Chemical Society;* **105**: No. 25, 7237-7240(14 Dec 1983). Contract AC03-76SF00098.

Quasirelativistic SCF-Xα scattered-wave calculations are presented for di-π-[8] annuleneuranium (IV) (uranocene), -thorium (IV) (thorocene), and -cerium (IV) (cerocene). Improved agreement over previous nonrelativistic results is found for both spectra and photoelectron spectra. An explanation is presented for the apparent relative success of the previous nonrelativistic calculations. The quasirelativistic calculations confirm that f/sub +/-2/ orbitals of the central metal atom contribute to the covalent ring-metal bonding, but they emphasize even more than the nonrelativistic treatment the important role of the 6d orbitals in such bonding. 2 figures, 2 tables.

26563 Process for the production of 5'-deoxy-5-[^{18}F]fluorouridine. Shiue, C.Y.; Wolf, A.P.; Friedkin, M. (to Dept. of Energy). US Patent Application 6-521,816. 10 Aug 1983. 10p. Contract AC02-76CH00016.

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Process for the production of 5'-deoxy-5-fluorouridine and the corresponding ^{18}F compound by the reaction of fluorine or acetyl hypofluorite with 2', 3'-di-O-acetyl-5'-deoxyuridine followed by hydrolysis.

26564 Heart testing compound. Knapp, F.F. Jr.; Goodman, M.M. (to Dept. of Energy). US Patent Application 6-509,077. 29 Jun 1983. 15p. Contract W-7405-ENG-26.

The compound 15-(p-[^{125}I]-iodophenyl)-6-tellurapentadecanoic acid is disclosed as a myocardial imaging agent having rapid and pronounced uptake, prolonged myocardial retention, and low in vivo deiodination.

26565 Synthesis and characterization of uranium(VI) chloride fluorides. Beattie, W.H.; Maier, W.B. II (Los Alamos National Lab., NM (USA)). *Polyhedron;* **2**: No. 12, 1371-1378(1983).

Uranium (VI) chloride fluorides were synthesized by the reaction of liquid HCl and solid UF_6 between -80 and -114 deg C. These dark red compounds are unstable above -40 to -60 deg C. The simplest formulas derived from compositional analysis are UF_3Cl and UF_4Cl_2.

26566 Monoclonal antibodies as physiologic probes. Mudgett-Hunter, M.; Budzik, G.P.; Donahoe, P.K.; Khaw, B.A.; Margolies, M.N.; Ridgeway, E.C.; Haber, E. (Massachusetts General Hospital, Boston). pp 101-128 of Basic biology of new developments in biotechnology. Hollaender, A.; Laskin, A.I.; Rogers, P. New York, NY; Plenum Press (1983). (CONF-8205198—).

From Symposium on the biological basis of new developments in biotechnology; Minneapolis, MN, USA (25 May 1982).

This report covers four independent studies exploring biomedical applications of monoclonal antibodies. The anti-digoxin hybridoma system illustrates: (1) a series of different monoclonal antibodies to a simple hapten can serve as a model system for studying the fine specificity of the antigen-antibody combining site; (2) high-affinity monoclonal antibody can serve as a reliable reagent in a clinical assay for the determination of drug levels such as digoxin in patients' sera; and (3) Fab prepared from monoclonal anti-digoxin antibody may serve as a therapeutic drug for the reversal of di-

goxin intoxication. Monoclonal anti-mullerian inhibiting substance (anti-MIS) antibody will facilitate the purification of MIS by affinity chromatography. Monoclonal anti-MIS antibodies will aid in the detection of both the site of cellular production of MIS and the receptors for MIS; will allow the development of a clinically useful RIA for the detection of MIS in tissue extracts, serum, and urine; and will serve as physiologic probes in the study of the potential role of MIS as a chemotherapeutic reagent. The high degree of specificity by the monoclonal anti-thyroid stimulating hormone antibody (hTSH) should allow for studies on structure/function relationships, detection, and analysis of hTSH or hTSH-beta in the presence of other human glycoprotein hormones. The reduced affinity of anti-hTSH-beta 1/1 together with its specificity should permit the purification of hTSH or hTSH-beta by affinity chromatography. Another application is the use of the antibody as an immunofluorescent probe for hTSH-producing cells in the anterior pituitary.

26567 **Kinetic study of electron transfer reactions between plutonium(VI) and a series of N-alkylphenothiazines.** Pelizzetti, E. (Univ. di Torino, Italy); Woods, M.; Sullivan, J.C. *Inorganica Chimica Acta;* 76: L163-L164(1983).

The values of the reduction potentials of the alkylphenothiazines and the value reported for Pu(VI)/Pu(V), 0.9164 V, along with the excess of Pu(VI) used in these experiments, insure that the reactions go to completion. The integrated form of a first order rate law provided an adequate description of the experimental data. These observations were interpreted in terms of second order rate law. Second order rate constants were calculated. The uncertainty concerning the Pu(VI)/Pu(V) self-exchange rate precludes further elaboration of reaction mechanisms. 2 tables.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 25398, 25555, 25558, 25559, 25560, 25561, 25562, 25566, 25567, 25602, 26027, 26740, 26741, 26742

26568 (BNL—51714, pp 43-45) **Some ion-molecule reactions pertinent to combustion.** Koski, W.S. (Johns Hopkins Univ., Baltimore, MD). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

26569 (BNL—51714, pp 74-76) **Theoretical studies of chemical reactions of importance in flames.** Harding, L.B.; Wagner, A.F.; Bair, R.A.; Dunning, T.H. Jr. (Argonne National Lab., IL). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

Of the projects related to the combustion of hydrocarbons in flames which have been studied in the Group during the past year, details of the following two were given in this presentation: (1) reaction of hydroxyl radical with carbon monoxide; and (2) reaction of hydrogen atom with hydrogen cyanide. Other projects which have been concluded during this period, but not yet published are isotope effects in the reactions Ha2 + CH_3 and H + CH_4. Rate constants have been calculated for the reaction H_2 + CH_3 → H + CH_4 and its reverse, and all of the deuterium-substituted analogs. 8 references.

26570 (BNL—51714, pp 80-84) **Variational transition state theory.** Truhlar, D.G. (Univ. of Minnesota, MN). 1983. NTIS, PC A12/MF A01. (CONF-8305158—).

From Combustion research contractors' meeting; Upton, NY, USA (24 May 1983).

During the past two years we have extended te variational transition state theory in several ways. Especially notable is that we have developed several new methods for calculating tunneling probabilities, including general techniques applicable to systems with small and large reaction-path curvature. We have tested these methods successfully against accurate quantal calculations, and we have applied them to real systems in three dimensions. We have also developed general algorithms for variational transition state theory calculations on polyatomic systems and we have applied these to the combustion reaction OH + H_2 → H_2O + H. We have developed and successfully applied a statistical-diabatic theory for state-selected rates. We made a totally ab initio prediction of the absolute chemical reaction rate for the reaction Mu + H_2 → MuH + H, using an accurate potential energy surface and methods that we had demonstrated to be reliable by tests against accurate quantal collinear results, and this prediction has now been confirmed by experiments. Some other studies include: (1) non-linear Arvehnius behavior for the isotopic reactions D + H_2 and Mu + H_2; (2) calculation of rate constants for the reactions Mu + D_2 → MuD + D in both one and three dimensions; (3) testing of variational transition state theory with small-curvature-tunneling semiclassical adiabatic ground-state transmission coefficients for the three-dimensional ractions H + BrH → HBr + H and D + HBr → DBr + H against coupled-channel quantal dynamic rate coefficients for the same potential energy surface.

26571 (DOE/ER/13067—T2) **Apparatus for kinetic measurements on elementary fossil fuel combustion reactions over wide temperature ranges. Final report, 1 May 1983-30 April 1984.** Fontijn, A. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemical and Environmental Engineering). Apr 1984. Contract AC02-83ER13067. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011390.

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A High-Temperature Photochemistry (HTP) reactor facility, designed and constructed under this one year contract, is described and discussed. It is suitable for kinetics measurements on isolated elementary hydrocarbon oxidation reactions in the 300 to 1800 K temperature range.

26572 (LA—9911-C-Vol.1, pp 95-108) **Behaviour of burning kerosene, aerosol formation and consequences.** Jordan, S.; Lindner, W. (Kernforschungszentrum Karlsruhe, Germany). Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Experiments have been performed to study the behavior and the consequences of burning kerosene, tributyl phosphate (TBP), and HMO_3 mixtures. The burning rate of kerosene/TBP solvent depends on the burning area. In the open air the rate increases from 80 kg/m^2 . h for 0.1 m^2 to 120 kg/m^2 . h for 2 m^2 burning area. In closed vessels the burning rate is about 40% lower than in the open air. The fire stops when the oxygen content is between 12% and 18%, depending on the TBP-concentration and the burning area. The release of nitric acid from inorganic/organic mixtures depends on the volume ratio of kerosene to HNO_3 and on the pool depth. The aerosol formation rate depends on the burning rate and is higher in the open air than in closed vessels. The released primary soot particles agglomerate already in the flame to aggregates of 10^1 to 10^3 particles. The aerodynamic diameter of these aggregates is in the range of 0.2 to 0.4 μm. Different filter devices have been tested for their use in soot particles filtration. Retention factors and loading capacities were determined. Multilayer sand-bed filters were developed and optimized for use as safety filters in reprocessing plants.

26573 (LA—10019-MS) **Chemical kinetics in hydrogen-air flames.** Sullivan, J.H. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011002.

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This report describes a chemical reaction mechanism for hydrogen-air flames. The mechanism includes the minimum number of elementary reactions that are necessary to reproduce macroscopic flame properties. The elementary reactions, their rate coefficients, and a qualitative description of their contributions to the structure of the flame are given. It is suggested that the flammability limits are determined primarily by the chemical kinetics, but the lean

flammability limit is extended further into the lean region by preferential diffusion of hydrogen gas into the flame.

26574 **Polycyclic hydrocarbons (aromatic) and soot from practical combustion systems.** Longwell, J.P. (Massachusetts Inst. of Technology Cambridge, MA). pp 37-56 of Soot in combustion systems and its toxic properties. Lahaye, J.; Prado, G. New York, NY; Plenum Publishing Corp. (1983). (CONF-8108144—).

From NATO/AGARD workshop on soot in combustion systems; Le Bischenberg, France (30 Aug 1981).

Potential adsorbed mutagens in soot are found in high boiling temperature hydrocarbon fuels, and are also synthesized by high temperature pyrolysis, or rich mixture flames from all fuels containing C-H bonds. Various gases are sampled to remove soot, hydrocarbons, and the fraction of soluble material. Extractions are then analyzed by mass spectrometric techniques. Several compounds--methyl anthracenes, and methyl phenanthrenes, for example, are studied. Combustion systems are then studied to determine the interaction of these compounds in various diesel exhausts, The residential oilburner is found to produce mutagens. The combustion of homogenous fuel-air mixtures in the spark ignition automobile engine, and its PAH emissions, is studied. The high temperature pyrolysis of hydrocarbons used in the manufacturing of carbon blacks is investigated. These practical systems are then compared.

42 ENGINEERING

4201 General Engineering

REFER ALSO TO CITATION(S) 27640

26575 **(BDX—613-3060) Robotic deburring. Part 1. Preliminary observations.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Apr 1984. Contract AC04-76DP00613. 86p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84010766.

Preliminary findings are described about capabilities and limitations for robotic deburring of parts while maintaining 0.25-mm-maximum edge breaks. Robotic deburring of hand size and larger parts common to many Bendix programs has unique constraints and requires careful definition of robot needs. The report illustrates representative geometry considerations and defines robotic considerations.

26576 **(SAND—84-0397) Users manual for the laser welding code WELD2D.** Russo, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011167.

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The two-dimensional laser welding code, WELD2D, was developed to model the conduction mode welding (weld pool motions are not considered) of common metals. For butt welded configurations two dissimilar materials may be used. Either Gaussian or uniform laser beam power distributions may be selected and insulated or conducting ends can be treated. Specification of the laser wavelength, energy per pulse, pulse duration and repetition rate is required as input and the temperature field and molten pool shape are calculated as functions of time. Currently material parameters for six metals, aluminum, nickel, steel, molybdenum, copper and silicon are included in the code; however, these may be modified or expanded easily with simple changes to data records. This report is a users manual for WELD2D and contains a description of the models employed, code usage, and sample calculations.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 25270, 25411, 25416, 25417, 25418, 25420, 25424, 25425, 25453, 25463, 25464, 25464, 25491, 25546, 25552, 25553, 25573, 25875, 26062, 26069, 26766, 26887, 26981, 27537, 27547, 27564

26577 **(AD-P—002457/0) Superconductive tapped delay lines for low-insertion-loss wideband analog signal-processing filters.** Withers, R.S.; Wright, P.V. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1983. 6p. NTIS, PC A02/MF A01.

Transversal filters have been realized as miniature superconductive tapped electromagnetic delay lines. The low loss of superconductors permits the use of a compact stripline structure which offers useful delay at microwave frequencies. Taps are realized as backward-wave couplers or a impedance discontinuities. Chirp filters are formed by cascading such couplers of increasing length. Pulse expansion and compression have been demonstrated over a 2.6-GHz bandwidth. By weighting the taps, side-lobe levels have been reduced to 25 dB below the peak output. A coupled-mode analysis has been employed for predicting the response of this class of filters and has achieved very good agreement with experiment. The analysis also predicts that, if coupling were increased to reduce insertion loss below about 10 dB, significant phase distortion results with a commensurate degradation of side-lobe levels.

26578 **(ANL/FE—84-6) Ceramic heat exchanger design methodology. Final report.** Smith, K.O. (Solar Turbines, Inc., San Diego, CA (USA)). Jan 1984. Contract W-31-109-ENG-38. 74p. NTIS, PC A04/MF A01. Order Number DE84010581.

This document describes the methodology employed by Solar Turbines Incorporated in designing a high pressure, ceramic heat exchanger test module. The unit was designed and fabricated to demonstrate and advance the use of structural ceramics in a typical industrial heat exchanger configuration. The specific configuration adopted is an axial-counterflow unit with ceramic tube heat exchanger elements and a ceramic exhaust header at the high temperature end of the module. Such a unit has potential for use in coal gasification, indirectly-fired gas turbine, and industrial heat recovery applications. The design methodology description includes the procedures and analytical relations associated with the thermal, fluid mechanical, and structural aspects of ceramic heat exchanger definition.

26579 (CONF-830528—Vol.1, pp 91-99) **Protecting against failure by brittle fracture in ferritic steel shipping containers.** Schwartz, M.W.; Langland, R.T. (Lawrence Livermore National Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Contract W-7405-ENG-48.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The possible use of ferritic steels for the containment structure of shipping casks has motivated the development of criteria for assuring the integrity of these casks under both normal and hypothetical accident conditions specified in Part 71 of the Code of Federal Regulations. The US Nuclear Regulatory Commission Regulation Guide 7.6 provides design criteria for preventing ductile failure steel shipping containers. The research described in this paper deals with criteria for preventing brittle fracture of ferritic steel shipping containers. Initially guidelines were developed for ferritic steel up to four inches thick (I). This was followed by an investigation of various criteria that might be used for monolithic thick walled casks greater than four inches thick (2). Three categories of safety are identified in the design of shipping containers. Category I, the highest level of safety, is appropriate for containment systems for spent nuclear fuel and high level waste transport packaging. In Category I, containers are designed to the highest level of safety and brittle fracture is essentially not possible. Categories II and III represent levels of safety commensurate with the consequences of release of lower levels of radioactivity. In these latter categories, consideration of factors contributing to brittle fracture, good engineering practice, and careful selection of material make brittle fracture unlikely under environmental conditions encountered during ship-

ping. This paper will deal primarily with Category I containers. The guidelines for Category II and III containers are fully described elsewhere. 5 references, 10 figures, 3 tables.

26580 (CONF-830528—Vol.1, pp 110-116) **Mechanical requirements for materials of accident proof packagings of radioactive materials.** Aurich, D.; Droste, B.; Helms, R.; Ziebs, J. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The evaluation criteria for material selection in the Federal Republic of Germany be pointed out, especially when ferritic nodular cast iron casks for the transport of spent fuel elements will be used for intermediate storage purposes, where additionally the withstanding of an aircraft crash has to be proved. 4 references, 4 figures.

26581 (CONF-830528—Vol.1, pp 119-125) **Properties of nodular ductile graphite cast iron used in GNS-manufactured spent fuel casks.** Rollins, J. (GNS, Roswell, GA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

GNS manufactured nodular cast iron has sufficient fracture toughness to ensure the structural integrity of spent fuel shipping casks even under accident conditions. The fracture toughness appears to be only slightly loading rate sensitive. There is no significant anisotropy in this material. The material can be produced in thick sections when only a slight through-thickness property gradient. Critical flaw sizes associated with stress levels which may be encountered in a nine-meter drop-test of a shipping container are well above the detectibility of conventional NDE. GNS has had considerable experience in the production of approximately twenth large casks since the material described in this test program was produced. This has lead to the improvement of production control procedures. A substantial safety margin exists in the properties of currently produced nodular cast iron in comparison to the values of material from the full-scale prototype cask drop-tested. 5 references, 5 figures.

26582 (CONF-830528—Vol.1, pp 126-131) **TN 1300 casting process and material qualification.** Anspach, W. (Transnuklear GmbH, Hanau, Germany); Wolters, D. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The casting process and the steps taken to qualify the material are described. Results of material testing and acceptance criteria are given. 2 references, 1 figure, 4 tables.

26583 (CONF-830528—Vol.1, pp 132-139) **Design criteria for nodular cast iron shipping containers.** Schwartz, M.W.; Boyce, L. (Lawrence Livermore National Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Contract W-7405-ENG-48.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Ductile failure criteria, fracture initiation criteria, and testing for response to accident loads are discussed. 15 references, 7 figures.

26584 (CONF-830528—Vol.1, pp 140-142) **Assessment of cast irons for structural components in nuclear material transportation systems.** VanDenAvyle, J.A.; Salzbrenner, R.; Trujillo, A.A. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper addresses probable structural design requirements for thick-walled shipping casks and the relationship of these requirements to the data base presently existing for ductile cast iron. Suggestions are made for further testing to improve the data base.

26585 (CONF-830528—Vol.1, pp 224-230) **Qualification and certification criteria of casks for the intermediate dry storage of spent fuel in the Federal Republic of Germany.** Droste, B.; Huebner, H.W.; Probst, U. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

As a part of the back end of the nuclear fuel cycle policy of the German Federal Government, the intermediate storage (up to a period of 40 years) of spent fuel elements is seen to be one step on the way to the reprocessing and/or final storage. The alternative to the method which is now practiced, i.e. the intermediate storage in pools (wet storage), this is the intermediate storage in transport casks under dry conditions. With regard to realistic assumptions, the latter will probably be that one to be realized in the FRG in the next years. The ability of already existing spent fuel element cask designs to serve as storage casks led to the fact that in the FRG, four facilities for the intermediate dry storage of spent LWR fuel elements in type B(U) casks are now in the licensing procedure stage: two away-from-reactor (AFR) facilities in Gorleben (Lower Saxony) and Ahaus (North-Rhine Westfalia) with a storage capacity of 1.500 t uranium each; and two at the reactor (AR) facilities at the nuclear power plants of Wuergassen and Stade with a storage capacity of 120 t/240 t uranium. The advantage of the storage in casks-concept is to build a storage facility according to the MAT principle (variable assembly of units) considering the actual need for storage capacity with extension possibilities. Another advantage is the inherent safety and security of the fuel by the cask itself in comparison with the need for additional active systems (e.g. for cooling purposes etc.) for a pool or vault storage facility. The evaluation of such active systems requires more expanded and sophisticated investigations, controlling and analyses. 3 references.

26586 (CONF-830528—Vol.1, pp 253-257) **TN 17/3: a cask designed for the transport of irradiated fuel to a post-irradiation examination facility.** Kirchner, B.; Blum, P. (Transnucleaire, Paris, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The TN 17/3 packaging is a particular member of the TN cask family, the only one having been designed against Section VIII of ASME Code for possible stamping as pressure vessel. Nevertheless this cask presents the major advantage of not being a prototype from licensing, fabrication, operation and maintenance points of view, as it is very similar to the TN 17/2 packaging which is now currently used for international transports of irradiated fuel to reprocessing plants.

26587 (CONF-830528—Vol.1, pp 258-267) **Design of radioactive material shipping packaging for low-velocity puncture resistance.** Nickell, R.E. (Electric Power Research Inst., Palo Alto, CA); May, R.A. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A recent paper (2) has offered a perspective on the design of transport packagings containing large quantities of radioactive material relative to the impact event - a 30 ft (9 m) drop onto an essentially unyielding target. In that paper, it was shown that modern tools of computational mechanics, incorporating elastic-plastic materials response and finite strain kinematic descriptions, could be used efficiently for the iterative design of a monolithic steel containment system, including models for bolted closures, shear keys, and seals. The second event in the accident design sequence - the 40-in. (1-m) drop of the packaging, after primary impact, onto a mild steel cylindrical punch is addressed. The regulations describe the geometry of the punch in some detail - 6 in. (15 cm) diameter, at least 8 in. (20 cm) long, with the edges of the cylindrical punch

at the top surface rounded to no more than a radius of 1/4 in (6 mm). The length requirement is intended to ensure that the essentially unyielding support surface for the punch does not make contact with the package until maximum penetration damage has taken place. The rounded edge requirement is intended to ensure that shearing action at the punch periphery is reasonably severe. 6 references, 7 figures.

26588 (CONF-830528—Vol.1, pp 277-282) **Interactions between crush conditions and fire resistance for type B(U) packages less than 500 kg.** Huebner, H.W.; Masslowski, J.P. (Bundesanstalt fuer Materialspruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In the continuation of the research work by BAM and the Commissariat a l'Energie Atomique (CEA), France, a study was made of the increased risk in regard to low-probability accidents, involving small, type B packages. An evaluation was made of the increased risk when small, type B packages are involved with a low-probability accident - one that involves both crush forces and exposure to a hydrocarbon fire. 3 references, 3 figures.

26589 (CONF-830528—Vol.1, pp 371-378) **New method to repair uranium hexafluoride cylinders.** Steinebach, E.F.M. (Urenco, Almelo, Netherlands). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Tests of a patch made of polyester/epoxy resin have shown that an opening in a cylinder filled with UF_6 can quickly and effectively be closed. The adhesion of the prepared patch seems adequate for subsequent transport for expert emptying of the cylinder. 1 reference, 18 figures.

26590 (CONF-830528—Vol.1, pp 382-389) **Thermal diode cooling fin concept.** Lyall, H.G.; Watts, J. (Berkeley Nuclear Laboratories, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The heat input through the finned portions of the walls of a water-filled fuel transport flask during an accidental, hydrocarbon fire can be halved by the replacement of narrow, solid fins by wider, hollow fins of similar pitch. In a flask with lid and base heat-shields this has the effect of reducing mean water temperature rise by about one third. These savings are achieved at the relatively small expense of slightly increased (by about 1 degC/kW of decay heat load) pre-fire normal operating water temperatures. 7 references, 3 figures, 5 tables.

26591 (CONF-830528—Vol.1, pp 390-398) **Development of packaging for plutonium oxide powder.** Oshima, H.; Kubo, M. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki-ken, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The packaging has been developed as a packaging for plutonium oxide to be recovered from light water reactor spent fuel and is designed for easy handling within a facility. As deformation and shock absorption data for balsa wood, the data obtained from various experiments carried out when developing the packaging were used. With this packaging, it is possible to transport almost all kinds of raw powder materials required to produce fuel as stated under Section 2 not only in the country but also from abroad. The packaging is expected to be frequently used in transporting plutonium oxide powder from England and/or France which are commissioned by domestic power companies to reprocess spent fuel and also in transporting highly enriched uranium oxide which is required at FBR experimental reactors. 14 references, 5 figures, 4 tables.

26592 (CONF-830528—Vol.1, pp 418-422) **Development of a new DOT-7A, Type A corrugated metal waste container at the Rocky Flats Plant.** Peter, K.G.; Brugger, R.P. (Rocky Flats Plant, Golden, CO). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A new transuranic waste container to be used for defense-related radioactive waste has been developed. The container body is constructed of 14-gauge low-carbon steel with horizontal corrugations spaced 3-in. apart center-to-center. The corrugations are designed in such a way to act as energy absorbers during the 4-ft drop test. In addition, they provide flexibility during the reduced pressure and compression tests. As opposed to using structural members to provide rigidity, the box is designed to absorb shock and still maintain container integrity. The lid and bottom pieces, also constructed of 14-gauge low-carbon steel, are identical. They have upward pressed corrugations running along the width of the container and spaced 6-in. apart center-to-center. This configuration allows the containers to nest when they are stacked, resulting in better storage efficiency and less chance of the containers shifting when they are stacked. 3 references, 1 figure, 1 table.

26593 (CONF-830528—Vol.1, pp 423-424) **Design of new overpacks for UF_6 cylinders.** Housholder, W.R. (Nuclear Containers, Inc., Elizabethton, TN). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The design of Model 48-14 overpack for 14-ton UF_6 cylinders and Model 30S overpack for 2 1/2-ton UF_6 cylinders is described.

26594 (CONF-830528—Vol.1, pp 466-472) **Argentine developments for a Type B cask.** San Pedro, M. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A general description is presented of the first Argentine cask for the transportation of spent fuel elements from the Atucha I nuclear reactor, sited in Lima, Buenos Aires Province, to the Ezeiza Atomic Center where a reprocessing plant is being built. The transportation will be through 150 kilometers of road surface. Some characteristics about the calculations that are being developed will be shown, taking into account that no destructive tests are planned on models in large scales for the whole cask. 7 figures.

26595 (CONF-830528—Vol.1, pp 545-552) **Testing of the Model 48-14 overpack for UF_6 cylinders.** Stitt, D.H. (Paducah Gaseous Diffusion Plant, KY). Dec 1983. NTIS, PC A99/MF A01. Contract W-7405-ENG-26.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Shipment of UF_6 enriched to 1.0% or greater assay ^{235}U currently is done in either the 30-B overpack or the Paducah tiger overpack. The former contains a 2-1/2 ton cylinder, 30 in. in diameter, while the latter contains a 10-ton cylinder, 48 in. in diameter. There are apparent economy and safety considerations associated with shipping in the larger containers due to the reduced number of shipments and connect and disconnect operations. Further reductions in connect and disconnect operations and shipping costs could be achieved through use of the 14-ton cylinder for shipment of enriched material. With this thought, a program was initiated in 1980 to develop a protective overpack for the Model 48Y cylinder. Two prototype overpacks of wood and stainless steel construction were fabricated. The results from the drop tests and the thermal exposure test are presented.

26596 (CONF-830528—Vol.1, pp 633-637) **Containment system evaluation.** Lake, W.H. (US Nuclear Regulatory Commission, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper discusses containment review practices of the US Nuclear Regulatory Commission (NRC) and describes, as necessary, the bases and rationale behind these practices. This is done by discussing the NRC's general practices, followed by a discussion of some specific containment issues. The specific containment issues are addressed in terms of the stated practices. 10 references.

26597 (CONF-830528—Vol.1, pp 638-645) **Criteria for and proof of leaktightness concerning casks for dry transport and intermediate storage of spent LWR-fuel elements.** Kowalewsky, H. (Bundesanstalt fuer Materialpruefung, Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Using a model cask with typical dimensions, typical radioactive contents and a typical sealing system, some general aspects of its leaktightness assessment will be outlined quantitatively. Taking into account molecular as well as viscous-laminar gas flow it will be shown that under pessimistic assumptions standard helium leakage rates less than some 10^{-2} mbar . l/s for transport and less than some 10^{-4} mbar . l/s for accident conditions must be guaranteed in order to meet the activity release limits required by the 1973 IAEA Regulations. Realistic calculations of the tritium activity release show that the contribution of tritium permeation through the cask wall is negligibly small even for storage times up to 40 a. Finally some radiation protection considerations concerning the relationship between activity release and radiation exposure will be presented. On the basis of these considerations we recommend to retain the activity leakage rate limit of $10^{-3}A_2$ per week after Type B tests as it is requested in the 1973 IAEA Regulations. 13 references, 10 figures.

26598 (CONF-830528—Vol.1, pp 664-671) **Factors influencing the design and assessment of elastomer seals for nuclear fuel transport flasks.** Chivers, T.C.; George, A.F. (Berkeley Nuclear Labs., England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A method of designing elastomeric seals to survive speculated accident conditions has been discussed. A satisfactory outcome requires considerable information on different aspects of elastomeric performance. In certain areas where the detailed mechanistic understanding is being developed, the design procedure involves pessimistic bounding techniques in conjunction with specific experimentation. The methods advocated permit a satisfactory seal design to be evolved and assessed for performance. 3 references, 5 figures.

26599 (CONF-830528—Vol.1, pp 672-679) **Fundamental studies on the performance of O-ring for cask.** Ebisu, T.; Yamamoto, M.; Maekawa, H.; Onodera, A. (Hitachi Zosen Corp., Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Conclusions obtained from this study are: sealing performance of rubber O-ring should be evaluated by the peak initial contact pressure (Pci*) and compression set test provides reliable estimation of the durability of rubber O-ring. Value of Pc(min) has not been obtained because of lack of experimental data. Practically, Pc(min) is considered to be approximately 5 kgf/cm² from the result of liquid leakage detection. Consecutive studies on Pc(min) should be developed with regard to the surface conditions at contact zone and elastic property of rubber. Practical guide for the design of groove has been proposed. A method for minute liquid leakage detection has been developed. 2 references, 9 figures.

26600 (CONF-830528—Vol.1, pp 747-754) **Behaviour of UF_6 package in fire: comparison of calculations with fire experiment.** Duret, B.; Bonnard, J.C. (Service des Transferts Thermiques, Grenoble, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Experimental and theoretical results are presented to facilitate a better understanding of the thermomechanical behaviour of industrial containers of UF_6 without a protective shell during a fire. Both localized and generalized fires have been considered involving either 48Y, 48G or 30B packages. 5 references, 7 figures, 2 tables.

26601 (CONF-830528—Vol.1, pp 755-762) **Thermal trials on a water-cooled LWR flask.** Burgess, M.H. (Atomic Energy Establishment, Dorset, England); Spiller, G.T.; Livesey, E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The detailed experimental results have revealed a good physical understanding of heat-transfer processes both inside and outside the flask. The contribution of some processes is at present unquantifiable, but small adjustments to factors enables accurate predictions to be made. The knowledge gained will enhance the design of new flasks. Measured temperatures fit predicted variations to better than 1°C standard deviation, and absolute temperatures can be predicted to about 5°C accuracy. 2 references, 6 figures.

26602 (CONF-830528—Vol.1, pp 763-770) **Family of casks for transport of LWR spent fuel.** Sert, G. (Transnucleaire, Paris, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Heat dissipation, closure system, and internal arrangements are given for TN 12/1, TN 12/2, TN 13/2, and TN 17/2 cask models. These casks have the following advantages: a large payload, based upon the rail and maritime modes of transport and only limited by the crane capacities at operation sites; a high operational reliability, backed by the experience which has been gained for 15 years by Transnucleaire with casks of similar operational features; and the standardization of the small components and tools which results in common operation procedures for the different models and facilitates the procurement of spare parts. 6 figures, 1 table.

26603 (CONF-830528—Vol.1, pp 771-778) **Widely useful stainless-steel forging B(U) packaging.** Yokoyama, H.; Higashi, K.; Takada, K.; Nagahama, H.; Tamamura, T. (Kobe Steel, Ltd., Hyogo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Introduced here are the general description, safety analysis, licensing, fabrication and inspection for a dry type general-purpose B(U) packaging of forged stainless steel. Since the packaging is of a dry type, the description will be focused on the temperature-distribution evaluation which is thought to be more complicated in modelling as compared with the wet type packaging. The first international transportation of the spent fuels by this packaging was done in 1982.

26604 (CONF-830528—Vol.1, pp 800-801) **Development of a transport cask for contaminated steam generators.** Temus, C.J. (Chem-Nuclear Systems, Inc., Bellevue, WA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The development of the SGC-1 cask is a major step by the radioactive waste transportation industry toward meeting the needs of the nuclear industry. This package represents the largest radioactive waste package that is presently licensed. It allows for economi-

cal solutions to the problems of transportation and disposal of large contaminated hardware.

26605 (CONF-830528—Vol.1, pp 822-826) **Design concept for a defense high level waste shipping cask: truck.** Moore, R.L. (GA Technologies, San Diego, CA); Zimmer, A.; Wilmot, E.L.; Shirley, C.G.; Romesberg, L.E. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The DHLW shipping cask is designed to contain one canister of solidified DHLW as produced by the DWPF as the authorized contents. The design basis DWPF canister is 609.6 mm (24.0 in.) in diameter by 2997.2 mm (118.0 in.) long and has a loaded weight of 2356.5 kg (5195.2 lb). Each canister contains about 290,000 Ci of activity and has a surface dose rate of 8750 rem/hr. The neutron dose rate of 5 mrem/hr is insignificant when compared to the gamma dose rate; therefore neutron shielding will not be required nor will it be provided on the DHLW shipping cask. Decay heat output is a modest 811 watts. Canisters are fabricated from type 304 stainless steel with a wall thickness of 9.53 mm (0.375 in.). Subsequent to pouring the molten waste into the canister, the outer surface is cleaned and decontaminated and a plug is fusion welded into the 127.0 mm (5.0 in.) opening in the top of the canister. 1 reference, 2 figures.

26606 (CONF-830528—Vol.2, pp 879-885) **Drop from the reactor building crane: an event covered by the 9-m drop test requirement.** Wieser, K.E.; Jais, M.; Holzloehner, U. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Transport packagings with spent fuel elements are handled by a so-called half-portal crane in heights of about 25 m (after having left the containment via the refueling slot) as far as German Biblis type PWR reactors are concerned. Owing to the fact that these half-portal cranes have to meet more minor regulatory requirements than those operating within the containment, their failure, and therefore the drop of the cask, has to be assumed. The drop then will happen from a height which lies beyond the 9-m height approved by the type B testings. There is a major concern from the regional authorities whether the activity release limits, set by the IAEA regulations, are still met. Test conditions were as follows: full-size spent fuel cask, type CASTOR Ic with simulated contents; yielding target, representing the ground conditions of the industrial driveway under the half-portal crane; drop height about 20 m at ambient temperature; and side-on drop position. The cask is an 83-ton cast iron design with rigid axial oriented ribs and a double lid system and shock absorbers on both ends, which are quite similar to the type CASTOR Ia prototype. The side-on drop position was chosen because earlier investigation had shown that this position would affect the cask integrity most. In addition, this position was necessary to compare the results of this drop with preceding licensing tests with the cask type CASTOR Ia prototype directly.

26607 (CONF-830528—Vol.2, pp 886-893) **Experimental impact and puncture evaluation of the prototype quarter scale TRU transporter package.** Meyer, R.J. (GA Technologies, Inc., San Diego, CA); Plonski, B.A.; Vigil, M.G.; Joseph, B.J. Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The impact tests consist of the TRUPACT model free-falling 9 meters onto a flat, horizontal, unyielding surface as specified in 10CFR71. The model was dropped at five different orientations including: (1) flat on the door end; (2) flat on the side; (3) center of gravity over impact corner; (4) flat on edge; and (5) corner impact edge slapdown. The model instrumentation for these tests included: (1) sixty strain gages located throughout the model structure used to obtain impact stresses; (2) three displacement transducers used to measure relative motion between the inner door and inner cavity frame structure (seal integrity); and (3) two triaxial accelerometers used to estimate the impact forces on the inner and outer frame structures. The drop/puncture tests consisted of the TRUPACT-I model free-falling one meter onto a 38-millimeter (1.5-inch) diameter mild steel punch 0.9 meters (36 inches) long. The punch was welded to an unyielding surface. Model drop/puncture orientations included: (1) flat on the model sides; (2) flat on the door and back ends; and (3) model center of gravity over impact point at various locations of the model (door end, back end, near door seals, near tubular frame structure, center of panels). The test results and subsequent analysis of the data have been used to support the final design of TRUPACT-I and to determine the most damaging impact and puncture orientations for testing the full scale prototype.

26608 (CONF-830528—Vol.2, pp 894-901) **Study of the influence of target material on impact damage.** Blythe, R.A. (Central Electricity Generating Board, Gloucester, England); Holt, P.J.; Miles, J.C. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A limited data base relating to target material behaviour under controlled impact conditions has been established. The trends indicated by the use of simplified missiles have been confirmed by a series of 1/8 scale model flask tests. Reasonable correlation has been achieved between experimental results and theoretical predictions. However, none of the mathematical models utilized has been found to be suitable for application across the entire range of target materials tested. Of particular interest is the fact that, for the missile and model flask described here, the harder rocks exhibit no reduction in impacter damage when compared with the IAEA target. However, engineered targets (such as concrete and bricks) appear to exhibit significant reductions in impacter damage. It is hoped that this data, in conjunction with that already being obtained from further work, will allow better estimates of flask damage to be made in the future, using purely analytical methods. 6 references, 8 figures.

26609 (CONF-830528—Vol.2, pp 918-926) **Feasibility study for scaling ferritic spent fuel casks for drop tests.** McConnell, P. (Fracture Control Corp., Goleta, CA); Jones, J.W.; Nickell, R.E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Within appropriate constraints, scale-model drop testing for demonstrating cask integrity is technically and practically feasible. Structural response and potential for crack initiation (fracture toughness) can be scaled. The flaw sizes assumed in this scaling analysis are a significant proportion of the cask wall thickness. The minimum depth considered was one-tenth the wall thickness. Detection of such flaw sizes are well within the capability of conventional NDE. The stress values analytically calculated are believed to realistically represent those a cask would experience in a 9-meter side-drop. Since this first phase of the EPRI/Sandia TTC cask scaling program analytically demonstrated the feasibility for scaling, it remains to actually drop test a properly instrumented scale model cask to experimentally demonstrate the approach. This model cask should have a defect machined into the highest stress location. The full-size cask should be analytically characterized prior to drop testing the model. Ideally, a drop test would eventually be conducted on the prototype to confirm the scaling concept. In addition to demonstrating the scaling concept, a successful drop test of a cask, be it model or prototype, would also demonstrate the potential of a linear-elastic fracture mechanics approach for ensuring structural integrity. 7 references, 3 figures.

26610 (CONF-830528—Vol.2, pp 950-957) **Large transport containers for nuclear reactor decommissioning waste.** Price, M.S.T. (United Kingdom Atomic Energy Authority, Winfrith, England); Lafontaine, I.; Dierckx, L.; Deramaix, P.; Demeester, J.; Wright, B.; Pflugrad, K. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The following topics are discussed: decommissioning alternatives; reference nuclear power plants; inventory of neutron-activated radionuclides; inventory of radionuclide contamination; regulations and transport category; means of transportation; and package design criteria.

26611 (CONF-830528—Vol.2, pp 1017-1023) **Design of a transportation cask for irradiated CANDU fuel.** Nash, K.E.; Gavin, M.E. (Ontario Hydro, Toronto). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

A major step in the development of a large-scale transportation system for irradiated CANDU fuel is being made by Ontario Hydro in the design and construction of a demonstration cask by 1988/89. The system being designed is based on dry transportation with the eventual fully developed system providing for dry fuel loading and unloading. Research carried out to date has demonstrated that it is possible to transport irradiated CANDU fuel in a operationally efficient and simple manner without any damage which would prejudice subsequent automated fuel handling.

26612 (CONF-830528—Vol.2, pp 1024-1031) **TN cask capabilities for transport of extended burnup fuel assemblies.** Macek, V.V.; Mason, M.E.; Guerra, V.G.; Goldmann, K. (Transnuclear, Inc., White Plains, NY). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The evaluations of the TN casks to transport extended burnup fuel showed: Shielding is the limiting factor for the TN-8L cask with over 10 years cooling time required for fuel with an assembly average burnup of 55,000 MWD/MTU. Reducing the number of assemblies from 3 to 2 or using a more realistic shielding analysis method or reduces the required cooling time to 3 to 4 years. Fission gas release rates are the limiting factor for the TN-9 cask due to the comparatively large fission gas release fraction used for extended burnup BWR fuel. Reducing the number of assemblies from 7 to 6 reduces the required cooling time from over 20 years to approximately 1 year. Heat rejection is the limiting factor for the TN-12Y cask. Reducing the number of PWR assemblies from 12 to 8 or the number of BWR assemblies from 32 to 27 reduces the required cooling time to approximately 5 years which is the design cooling time for the cask. In order to transport the high initial enrichment fuel required for extended burnup, partial loding of the casks are necessary to maintain criticality control unless other neutron absorption schemes are used or the regulatory agencies permit credit to be taken for fuel depletion due to burnup.

26613 (CONF-830528—Vol.2, pp 1040-1047) **TN-12Y packaging for rail transport of irradiated fuel.** Nolan, D.J.; Goldmann, K. (Transnuclear, Inc., White Plains, NY). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The TN-12Y is designed for the transport of 12 PWR or 32 BWR fuel assemblies cooled for a minimum of 5 years. The TN-12Y design incorporates design features which are common to all TN casks, i.e. dry transport under a slight vacuum, solid neutron resin shielding, passive heat rejection by natural convection and radiation. The maximum weight of the loaded cask on the crane hook is less than 100 tons. The maximum transport weight of the loaded cask is less than 96 tons permitting unrestricted interchange service on a 4 axle car with a maximum gross weight on the rails of 263,000 lb. End covers and trunnions are designed to limit inertia loadings during the 30 ft free drop regulatory accident to 100 g, so as to maintain the structural integrity of the fuel baskets for criticality control. Consolidated fuel can be accommodated by use of alternate baskets. 9 references.

26614 (CONF-830528—Vol.2, pp 1048-1054) **Selection and certification of materials for casks intended for the transport and intermediate storage of spent fuel.** Droste, B.; Huebner, H.W.; Probst, U. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In the Federal Republic of Germany, casks for the transport and intermediate storage of spent fuel have to meet the IAEA requirements for type B(U) packagings on the one hand and additional storage requirements on the other. The selection and qualification of materials, able to meet the above-mentioned requirements with regard to a wide range of loads both under service and accident conditions are summarized. This was done for spent fuel element casks of GNS-CASTOR type and the TN 1300 type. The evaluations by BAM were done by considering the IAEA transport regulations as well as the requirements of the German Atomic Law as far as the establishement of nuclear facilities are concerned. For the actual application procedure for the AFR storage facilities Ahaus and Gorleben, BAM has finished an expertise on the behavior of CASTOR casks both under normal and accident conditions.

26615 (CONF-830528—Vol.2, pp 1063-1069) **Upgrading the DOT 6M-2R shipping package.** Chalfant, G.G. (Savannah River Plant, Aiken, SC). Dec 1983. NTIS, PC A99/MF A01. Contract AC09-76SR00001.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

At the request of the Department of Energy, a program was initiated at the Savannah River Plant to redesign the 2R containment vessel to meet or exceed current or proposed regulations, and to take into account the requirement for double containment for plutonium powders, oxides, or scrap. New containment vessels were designed and tested under the following criteria: The containment vessel would be designed as a pressure vessel, in accordance with an established code (ASME Boiler and Pressure Vessel Code) for services up to 6895 k Pa (1000 psig) and temperatures up to 260°C (500°F). The vessel closure would be reusable, of high integrity and use a high temperature O-ring seal. Leakage rate of the closure would be $<10^{-7}$ atm cc/sec under normal and accident conditions. Material of construction would be tough and ductile under both the low and high temperatures experienced in transport. A QA/QC plan would be generated for the package, with the greater emphasis on significant features of the containment vessel. Leakage testing provisions would be designed into the containment vessel closure.

26616 (CONF-830528—Vol.2, pp 1095-1102) **Thermal analysis for the design of a CANDU irradiated fuel transportation cask.** Taralis, D.; Nash, K.E. (Ontario Hydro, Toronto). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Ontario Hydro has undertaken a program to design, license and build a prototype cask for transporting irradiated CANDU fuel by road. The present study covers one aspect of this program which deals with the thermal analysis of several alternative dry cask designs under normal operating conditions. The main objective of the analysis was to assist the design process by providing temperature data for evaluating the thermal characteristics of various cask designs, the intention being to confirm the absolute values of the fuel temperatures by testing once a particular design had been chosen. One of the principal concerns is to control the maximum fuel temperature to about 200°C or less to avoid excessive oxidation of any exposed uranium dioxide fuel. Due to the complexity of the cask internals the analysis was based on a combined theoretical and experimental approach. This paper describes the development of the analytical tools, presents and discusses the temperature results for a two-module cask and summarizes the major conclusions of the study. The major conclusions of this study are: At low decay heat levels (5 to 10 years cooling) external fins are not effective enough in terms of temperature reduction to warrant their expense

in manufacture and the penalty in decontamination performance. An air/stream mixture is the most efficient of the coolants considered, followed by CO_2, air and then helium. Significant reduction in the maximum fuel sheath temperature can be obtained by allowing adequate clearance between the cask inner surface and the fuel modules, particularly in the vertical direction. The design of the lid impact limiter has a significant effect on the fuel temperature. Full-scale experimental work is being planned to verify the results of this analysis.

26617 (CONF-830528—Vol.2, pp 1103-1112) **Natural convection cooling of circumferentially finned transport casks.** Doroszlai, P.G.K. (Electrowatt Engineering Services, Ltd., Zurich, Switzerland). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

It may be stated that for the calculation of the heat transfer coefficients for natural convection cooling of large-diameter finned surfaces it is necessary to take in consideration the effects of the fin length, fin material and of the azimuthal angle around the cylinder. The present results replace earlier less accurate correlations gained from the same measurements. The new, better correlation was elaborated with the aid of the improved method of evaluation of multiple parameters of a measurement matrix of multiple dimension (one dimension for each parameter), rendering the sum of the squares error a minimum at the same time for the complete matrix. 5 references.

26618 (CONF-830528—Vol.2, pp 1121-1129) **Results of fire resistance tests of spent fuel transporting container (50-ton type cask) using a furnace and investigation of a method of numerical analysis.** Yasuda, M.; Kobayashi, S.; Yamakawa, H.; Abe, H. (Central Research Inst. of Electric Power Industry, Chiba, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The spent fuel container used for transportation has to prove its safety and soundness under the various circumstances stipulated by IAEA regulations for the safety of radioactive material transportation. The Central Research Institute of Electric Power Industry conducted some corroboration tests of 50-ton type casks with the support of the Science and Technology Agency of the Japanese government. This paper describes the results of one test in which fire resistance was checked by using a furnace and tests of numerical analysis simulation taking the heat generation of combustibles on the surface of the outer cylinder into consideration.

26619 (CONF-830528—Vol.2, pp 1130-1137) **Facility for repeatable fire testing.** Gill, W. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A99/MF A01. Contract AC04-76DP00789.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

In support of the Lightweight Air-Transportable Accident Resistant Container (LAARC) program, a pool fire facility has been developed that provides a repeatable fire environment. This testing capability proved invaluable during the development phase of the LAARC package in that design changes could be evaluated with respect to the abnormal thermal environment without resorting to a statistical approach. The facility has since been used for a wide variety of fire tests including the development of fire instrumentation for the Department of Transportation Engulfing Fire program (1), the pursuit of an in-house heat transfer in fire study (2), and the thermal testing of TRUPACT container components (3). The purpose of this paper is to describe the facility, give the theory of operation, and discuss the relation between the thermal environment inside the facility and that in an open pool fire.

26620 (CONF-830528—Vol.2, pp 1164-1169) **Design and fabrication of 100-ton class spent fuel shipping cask (100-ton cask).** Abe, H. (Central Research Inst. of Electric Power Industry, Tokyo, Japan); Yasuda, M.; Fukuda, S.; Amano, K.; Ohashi, M. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Design specifications and fabrication details are reported.

26621 (CONF-830528—Vol.2, pp 1301-1308) **Fatigue design of TRUPACT-I.** Grenier, R.M.; Tow, D.; Villareal, R.J. (GA Technologies Inc., San Diego, CA). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper describes the development of fatigue design criteria and the application of these criteria in the design evaluation of the TRansUranic PACkage Transporter (TRUPACT-I). TRUPACT-I is a bimodal, Type B (M) packaging system designed to transport contact-handled transuranic (CH-TRU) waste.

26622 (CONF-830528—Vol.2, pp 1317-1325) **Two- and three-dimensional analyses of DHLW casks.** Osborne, D.M. (GA Technologies Inc., San Diego, CA); Grenier, R.M.; Rasmusson, P.C.; Nickell, R.E. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Coding developments in computational stress analysis have matured to the point that iterative design calculations are now possible. Utilizing two- and three-dimensional finite element codes - HONDOII and DYNA3D - truck and rail versions of the DHLW cask have been shown to survive drops from 9 m (30 ft) onto an unyielding surface. The rail cask has withstood a side drop simulation, and will survive a center-of-gravity over corner drop onto its closure end after only minor adjustments to the design. The truck version of the cask has survived simulated impacts onto its bottom end, both in flat-on and center-of-gravity over corner orientations, and the stresses calculated show good margin when compared to the allowables. To confirm the predictions of these analyses, scale model testing will commence in 1984.

26623 (CONF-830528—Vol.2, pp 1337-1341) **Guide to quality assurance measures for manufacturing and use of RAM packagings.** Wieser, K.E. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany); Roedel, R. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

More than three years of experience in the field of comprehensive Quality Assurance Measures has been gained by BAM within the licensing procedure for a multitude of type B package designs. Moreover and in parallel to the design-dependent licensing work, a guide for QA measures has been worked out due to the fact that the IAEA transport regulations are governing this matter only by a more general basic requirement. The envisaged 1984 revised edition will not significantly improve this insufficiency. We saw an urgent need for the establishment of such a guide to guarantee an equivalent level of quality and adequate means to its achievement. This guide was set in force at the end of 1982 by both the competent authority of the Federal Republic of Germany, the PTB and BAM after ballots with the industry concerned and federal ministries. It has to be applied to all package designs which have to be approved according to the IAEA transport regulations. Some of the essential requirements of this guide are highlighted to initiate international discussion points which are looked at to be differently ruled in IAEA member states.

26624 (CONF-830528—Vol.2, pp 1342-1348) **Discussion of Regulatory Guide 7.10, emphasizing the graded approach for establishing QA programs.** Gordon, L.; Lake, W.H. (US Nuclear Regulatory Commission, Washington, DC). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

To assist applicants in establishing an acceptable QA program to meet the programmatic elements of Appendix E to 10 CFR Part 71, Regulatory Guide 7.10 was developed. Regulatory Guide 7.10 is organized in three self-contained ANNEXES. Guidance applicable to designer/fabricators, to users, and users of radiographic devices are in separate annexes. QA programs for packaging to transport radioactive material are similar in regard to the various operations a licensee may be involved in. However, the appropriate QA/QC effort to verify the program elements may vary significantly. This is referred to as the graded approach. Appendix A in the guide addresses the graded approach.

26625 (CONF-830528—Vol.2, pp 1349-1354) **Experience and future prospects in maintenance and reinspection of LWR irradiated fuel transport flasks.** Lazarevitch, S. (Nuclear Transport Ltd., La Hague, France); Lenail, B.; Bernard, H. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper presents the philosophy and principles applied in La Hague for general work on flasks such as maintenance, reinspection, or repair. It also gives some information about the practical results we have obtained. As future prospects, we show how the work will be organized in La Hague when it will be possible to use the new facilities which are now under construction.

26626 (CONF-830528—Vol.2, pp 1355-1360) **Hands-off technique for the internal decontamination of fuel transport flasks.** Bridle, D.A.; Bird, E.J. (United Kingdom Atomic Energy Authority, Winfrith, England). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Decontamination of the internal surfaces of a 50-tonne Excellox type flask has been carried out at A.E.E. Winfrith by making the flask part of a circulating loop containing a solution of decontaminating reagent. Approximately 1.5 tonnes of reagent was circulated from a storage tank at flow rates up to 1000 litres per minute at a temperature of 80°C. A modified flask lid was designed and included a spacer which occupied the bulk of the internal volume of the flask. This spacer directed the flow and increased the linear velocity of the decontamination liquid across the flask surface. The main feed and return lines were brought through this lid with subsidiary pipework to drain and vent valves. Insulation of the flask and interconnecting pipework enabled the equipment and its circulating liquid content to be maintained at 80°C during the decontamination. Heating was achieved by means of electric immersion heaters in the reagent storage tank.

26627 (CONF-830528—Vol.2, pp 1366-1370) **Elastomere gasket: a black sheep for quality assurance measures.** Wieser, K.E.; Tobisch, K.; Probst, U. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

BAM proposes to introduce a data sheet which contains appropriate identification testings to ensure the compliance of the gaskets to be installed into the packaging with the ones of the approved design. This data sheet refers to national and international test standards in order to be also used in other countries.

26628 (CONF-830528—Vol.2, pp 1440-1446) **Safety analysis code systems for spent fuel cask in JINS.** Nomura, Y.; Mizuta, H.; Noguchi, H. (Inst. of Nuclear Safety, Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This paper presents some of the results obtained during establishment of the JINS code system.

26629 (CONF-830528—Vol.2, pp 1447-1454) **Experimental and analytical study on shielding of spent fuel shipping casks.** Maki, Y. (Central Research Inst. of Electric Power Industry, Chiba, Japan); Yasuda, Y.; Inoue, M.; Abe, H.; Sekiguchi, A.; Hasegawa, K.; Nakazawa, M.; Iguchi, T.; Ueki, K.; Yamakoshi, H. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

As a part of a reliability demonstration program for the nuclear spent fuel shipping cask, radiation shielding test experiments are in progress at CRIEPI (Central Research Institute of Electric Power Industry) under contract with the Science and Technology Agency of Japan. The present test casks specially prepared for this program are wet-type and each has the capacity to contain three PWR or seven BWR spent fuel assemblies. The whole weight is approximately 50 tons. We also have plans to examine 100 ton-class casks following this 50 ton-class test program. The test experiments for the reliability demonstration program have been based mainly on IAEA regulations for the safe transport of radioactive materials. They include the drop I test (9m drop), the drop II test (1 m drop onto a 15 cm bar), the thermal test (800°C, 30 minutes), and the high water pressure test that is a special test in Japan. In these test procedures, the main role of the shielding test is to validate the effective shielding ability of each test cask before and after those demonstrative test experiments. The shielding test procedure can be applied with satisfactory results for the validation of the radiation shielding capability of spent fuel shipping casks. The data can be used as good benchmark data for neutron shielding calculations of the spent fuel shipping cask, using a uniform cylindrical shell source of ^{252}Cf. The present calculations were found to be in good agreement with the experimental results, except for the neutron dose-rate around the normal cask equipped with the resin-shell.

26630 (CONF-830528—Vol.2, pp 1495-1500) **Operational experiences with the HZ-75T spent fuel shipping cask.** Onodera, A.; Nishikawa, A.; Ino, H.; Ozaki, S. (Hitachi Zosen Corp., Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The HZ-75T Spent Fuel Shipping Cask, has been used for transporting LWR spent fuel and some of the operational experiences are described below: (1) using four units of HZ-75T, total of 34 shipments (number of casks: 67) have been made since 1979; (2) external radiation and contamination levels are sufficiently low and average turnaround at power plant site is about 4 days; (3) in-service maintenances and inspections have been carried out in accordance with the Quality Assurance Program; and (4) the operating experiences will be taken into account in the future development of LWR spent fuel shipping cask.

26631 (CONF-830528—Vol.2, pp 1505-1512) **Packaging of United States Department of Energy toll enriched UF_6-experience, responsibilities, and improvements.** Pryor, W.A. (Dept. of Energy, Oak Ridge, TN). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The proposed modifications to existing and to new DOT Specification 21PF-1 overpacks for 76-cm (30-in) diameter UF_6 cylinders appears to be appropriate for enhancing safety and minimizing maintenance. The US-DOE Oak Ridge Operations Office has reviewed and concurs with the proposed designs. Recommendations have been made to the US-DOE Headquarters that the Department concurrently request a revision to US Nuclear Regulatory Commission Certificate of Compliance 4909 for both categories and that a petition be submitted to the US Department of Transportation to amend the current DOE Specification 21PF-1 (49 CFR 178.121). Once either or both actions are approved, toll enrichment customers will be encouraged to modify their existing 21PF-1 overpacks under the Category I proposal and to procure new 21PF-1 overpacks under the Category II proposal. In lieu of procuring new 21PF-1 overpacks, new design overpacks will also be encouraged

and will be acceptable. Regardless of which overpack is used, the owners and agents are responsible for maintaining overpacks in the proper condition for transport.

26632 (CONF-830528—Vol.2, pp 1569-1575) **Investigations on shock absorbers for type B packagings.** Wieser, K.E. (Bundesanstalt fuer Materialpruefung (BAM), Berlin, Germany); Masslowski, J.P.; Sieber, R. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The most commonly used RAM package shock absorber materials were tested. They are wood (Balsa, Spruce, Pine, Oak), phenolic foam, Celotex, Vermiculite, and wet plaster. In the case of the different types of wood, the grain orientation was considered because of its great influence on the deformation energy. No special precautions were taken considering humidity and temperature; both were normal with respect to manufacturing conditions. In order to evaluate the influence of encapsulations and, in the case of purling Vermiculite to enable a compression test, the static tests were performed both with and without a cylindrical housing. For the dynamic tests a mass of 64 kg was dropped from a height of 9 m on samples of the same dimensions.

26633 (CONF-830528—Vol.2, pp 1576-1583) **Development of a toroidal shell-type shock absorber for an irradiated fuel shipping cask.** Sugita, Y.; Mochizuki, S. (Mitsui Engineering and Shipbuilding Co., Ltd., Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

This study described the design method of a toroidal shell-type shock absorber and the dynamic responses of the cask body, the internal structure and water when this shock absorber was used. Conclusions are: the calculated results on the basis of the master curves of non-dimensionalized force-deflection relations by static compression tests show a close agreement with the experimental results; the internal structure moves together with the cask body in every position; and the maximum water pressure is larger by a factor of 1.2 than the static pressure multiplied by the maximum deceleration in every direction due to the low-frequency wave propagation.

26634 (CONF-830528—Vol.2, pp 1584-1590) **Analysis of the behaviour under impact loads of a shell-type shock absorber for LWR spent fuel transport packaging.** Aquaro, D.; Forasassi, G. (Univ. of Pisa, Italy). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The results of the test data elaboration, besides other considerations, provide: an inside view of the real deformation mechanism of this type of shock absorber; validation of the design calculation performed by means of FE codes; verification of the possibility of using the model test data for the prototype, on the basis of statistical checks and dimensional analysis; and a test of the actual structure capability to limit the dynamic load transmitted to the foreseen package body. 4 references.

26635 (CONF-830528—Vol.2, pp 1591-1597) **Analysis method for the design of transport packaging shock absorbing end covers.** Nolan, D.J. (Transnuclear, Inc., White Plains, NY); Fernandez, C.; Miller, C. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The analysis method used to design the shock absorbing end covers of the Transnuclear TN-12Y transport packaging is described. The method uses the basic equations of motion (i.e. F = ma) which were programmed for computation with an Apple II computer. Inertia loadings for various positions of the model with respect to the target surface were calculated to determine the worst position to meet the requirements of 10CFR71. For most cover designs evaluated the inertia loading for small angles of inclination at impact with the target surface were larger than for a horizontal position because of the slap-down effect. Different crushable materials were evaluated including the effect of their variation in crushing stress and locking strain. The design was optimized to limit the maximum inertia loadings for the worst impact position to a value of 100 g. 8 references.

26636 (CONF-830528—Vol.2, pp 1598-1604) **Impact limiter design methodology.** Meinert, N.M. (Nuclear Assurance Corp. (NAC), Atlanta, GA); Wells, A.H. Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

Spent fuel shipping casks must be designed to withstand the effects of normal operation and hypothetical accident load conditions. Included in these load conditions are a fall from one foot for normal operation and from thirty feet onto an essentially unyielding surface for the hypothetical accident case. Often, sacrificial impact limiters are needed at each end of the cask to protect the cask's exterior and protruding fittings and to control the deceleration of the cask subsequent to the fall. The methodology presented in this paper can be used to size the limiter and to calculate the deceleration forces used to calculate the stresses imposed on the cask structure. The methodology described here is quasistatic; that is, each iteration freezes an instant in time during which all calculations (described below) are performed and then proceeds to the next instant in time. This makes the calculations easier to check to diagnose any undesirable events during impact(s). Also, it aids in optimizing the shape of the impact limiter.

26637 (CONF-830528—Vol.2, pp 1604A-1604B) **Shock response of flexible polyurethane foams.** Szanto, M.; Yossifon, S. (Nuclear Research Centre, Negev, Israel). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The responses to shock of polyurethane foams was examined by means of a drop system, all the experiments were performed on foams of the type Vibroless 240, having a uniform density of 240 kg/m^3. A mathematical model was constructed based on dimensional similitude parameters which included the geometric parameters of the foam, the mass of the absorbing body, the drop height, the maximum accelerations and the maximum deformations. In the drop tests we discerned three mechanisms of shock of the foam: drops at low shock energies, for which the response of the foam is felt at the beginning of the motion (apparently the beginning of the buckling of the foam structure); drops in the range of shock energies for which the cross-section of the foam remains nearly constant (changes up to 5% of the diameter); drops at very high shock energies for which significant change takes place in the cross-section of the foam. The mathematical model was adequate to the range of shock energies for which the foam cross-section remained relatively constant, and graphs derived from the dimensional similitude were obtained, from which one can predict, based on drop conditions (geometry, mass, drop height), the maximum acceleration, the maximum deformation, the percentage of energy absorption of the first shock response and the duration of the shock response.

26638 **(DOE/ET/17094—1503) Results of the HTHP ESP testing at Curtiss-Wright.** Kumar, K.S.; Feldman, P.L.; Jeselsohn, F.S. (Cottrell Environmental Science, Somerville, NJ (USA)). Mar 1984. Contract AC21-80ET17094. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009274.

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This report to the US Department of Energy discusses the testing and evaluation of the electrostatic precipitator (ESP) that was installed at the government owned pressurized fluidized bed combustor (PFBC) test facility located in Wood-Ridge, NJ and operated by Curtiss-Wright Corporation. Test data on a short term ESP operation at 1400 to 1500°F and 84 psia showed that particulate collection efficiencies in the range of 98 to 99.5% are possible

and have the potential for meeting DOE's particulate control goals ahead of the gas turbine. The key test program to evaluate the ESP at 1600°F and 94 psia could not be properly implemented because of severe damage to ESP internals prior to the test program. The damage was caused by several water floods into the ESP resulting from flow control upsets in the downstream pressurized water scrubber in the PFBC system. The damaged ESP showed particulate collection efficiencies in the 75 to 85% range. Recommendations are made for future course of study with the ESP so that the testing and evaluation program at 1600°F and 94 psia can be fully implemented.

26639 **(EUR—8017) Benchmark for the qualification of gamma shielding calculation methods for light-water type reactor spent fuels.** Blum, P.; Cagnon, R.; Nimal, J.C. (Commission of the European Communities, Luxembourg). 1982. 112p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84700940.

This report gives the results of a campaign of gamma dose rates measurement in the vicinity of a transport package loaded with 12 PWR spent fuel assemblies. It describes the measuring methods, and gives the accuracy of the data which will be useful, as benchmarks, to the control of the calculation methods used to verify the gamma shielding of the packages. It shows how to calculate gamma dose rates from the data given on the package and the fuel, and gives the results of a calculation with the Mecure IV code and compares them to the measurements.

26640 **(EUR—8030) Ability of type A packages to withstand regulatory tests. Final report.** Barsali, S.; Forasassi, G.; Orsini, A.; Piermattei, S.; Robert, M. (Commission of the European Communities, Luxembourg). 1983. 126p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84700986.

After a brief analysis of the concepts which characterize a type A package in accordance with the IAEA regulations, it is indicated that the main goal of the work is to verify if the most used type A packages in Italy actually meet the relevant regulatory requirements. Several specimens were selected and tested.

26641 **(EUR—8325) Intercomparison of the calibration of helium leaks for use in leak detection.** Gould, D. (Commission of the European Communities, Luxembourg). Sep 1982. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700974.

In view of the absence of internationally agreed standards for the calibration of reference leaks an intercomparison campaign has been carried out by three European Community laboratories to determine the level of agreement possible using different calibration techniques and, where necessary, the origins of disagreement. Four permeation and two capillary helium leaks in the commonly used range of 10^{-7} to 10^{-8}mbar.l.s^{-1} were circulated around the participating laboratories who were charged with calibrating each one five times while adhering strictly to an agreed set of guidelines. Results are reported.ks design required further consideration.

26642 **(EUR—8345) Criticality safety hazards arising from the transport of fissile materials. Final report.** Leigh, K.M.; Mather, D.J.; Shaw, P.M.; Rushton, K.C.; Hague, P. (Commission of the European Communities, Luxembourg). 1983. 99p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84700942.

A study has been made of hypothetical accidents to a particular design of transport flask. Two accidents are considered, one involving the sudden displacement of an element; the other, the movement of fragmented fuel from damaged pins. In both cases in order to make the system critical, it has been necessary to arbitrarily alter the calculated values of the effective multiplication factor. Two computer programs are used for the study. The first calculates the initial power pulse and its corresponding energy to the flask. The second program calculates the longer term diffusion of heat from the fuel through the clad and into the water. Since the study is hypothetical it has been possible to arbitrarily alter the peak values of the effective multiplication factor and determine how this affects the energy release. It is shown how the latter may be dependent also on the boundary conditions to fuel movement, as well as the Doppler effect due to fuel temperature rise and to the reactivity change from density reduction.

26643 **(EUR—8391) TPLOT: an interactive time plot system for transient structural problems.** Halleux, J.P. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700989.

The work presented in this report consists in creating adequate interfaces enabling the transfer of output data from programs and experiments to the data base and in modifying and adding commands in order to render the system more suited to fast structural dynamics problems. Furthermore, adequate data management command procedures have been developed in order to enable creation, saving and restoring in a fully automated way. This report contains a brief though hopefully complete documentation for the features available to the user of TPLOT.

26644 **(IAE—3583/10) Combined (NbTi+V_3Ga) superconducting solenoid.** Anashkin, O.P.; Kejlin, V.E.; Surin, M.I.; Verges, P.; Gladun, A.; Frentsel', Kh.; Khol'tskhojzer, V.; Ehkkert, D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701412.

A superconducting magnet system with the field of 12 T in the internal diameter being equal to 80 mm, comprising two concentric solenoids prepared respectively of NbTi and V_3Ga connected in series and supplied from one power source is described. Different superconducting materials (multicore superconducting wire prepared of NbTi in copper matrix and multicore V_3Ga superconductor prepared according to "bronze technology") required special measures for solenoid protection during the system transition into normal state. Degradation is absent in both solenoids. Transition to the normal state begins in the internal V_3Ga solenoid, at that reversible active resistance permitting to stop transition by current decrease appeares at the beginning.

26645 **(IFVE-OUNK—82-159) Thermodynamic analysis of a refrigeration cycle with flow imbalance.** Ageev, A.I.; Shamichev, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1982. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701413.

The analysis of the new refrigeration cycle, in which liquid helium flow from a liquefier is used as the source of cold in the precoolung stage, is given. Exergy losses in the cycle elements are analysed. It is determined that cycle efficiency strongly depends on a number of parameters, such as helium direct flow pressure, liquefier efficiency, minimal temperature difference between helium flows in the heat exchanger, the rate of helium input into the cycle. The refrigerator heat exchanger dimensions depending on helium flow imbalance and minimal temperature difference in the heat exchanger are presented.

26646 **(JINR—R-8-82-218) Stability and rate of superconducting magnet winding transition into normal state as a result of energy losses during energy removal.** Kabat, D.; Luppov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701415.

Calculations of the effect of energy losses on stability and rate of superconducting magnet winding transition into normal state under adiabatic conditions during energy removal are conducted. The effects of properties and parameters of conductors on stability and rate of this transition are investigated. Three solenoids with the maximum critical fields in their aperture of about 8 T are considered as examples. Estimates for the rates of transition into normal state of the solenoid windings are made. It is revealed that under the certain conditions the losses can trasfer the larger part of the winding into normal state. It is concluded that if there is a necessity to produce solenoid which should uniformly transfer into normal

state then it is necessary to chose a conductor with the maximum possible diameter and coefficient of filling.

26647 **(JINR—R-13-83-20) Cryostats for study of a substance using positive muons at low temperatures.** Grebinnik, V.G.; Zhukov, V.A.; Lazarev, A.B.; Manych, A.P.; Nikol'skij, B.A.; Selivanov, V.I.; Suetin, V.A.; Selivanov, G.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701414.

A descriptin of a few cryostats used for the investigation of a substance by muons plus is given. The cryostats allow one to maintain the temperature of samples to be investigated at high stability in the 4.2-300 K range. The system of stabilization and control of temperatures in this range is considered.

26648 **(LA-UR—84-868) Overview of raise boring and blind shaft drilling with practical applications and particular reference to design limits for accuracy.** Neudecker, J.W. Jr. (Los Alamos National Lab., NM (USA)). 18 Apr 1984. Contract W-7405-ENG-36. 18p. (CONF-8404126—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010055.

From 86. annual general meeting of Canadian Institute of Mining; Ottawa, Canada (15 Apr 1984).

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The current excavation technology of raise boring and blind shaft drilling operations is reviewed. Examples are presented of recent applications of both downhole boring machines and surface-mounted rotary shaft drilling equipment, with comparisons made of operational characteristics, shaft sizes, and accuracy limits of each system. Raise-boring and box-drilling machines are described and current operating practices of these systems are reviewed. The increased interest in slant hole or inclined shaft construction is noted, and techniques and equipment for these special shafts are presented. Practical accuracy limits are discussed for each shaft drilling technique and trade-offs between accuracy, drilling rates, and shaft utilization factors are noted. Finally, the current status of ongoing research and development efforts will be described, and some predictions made regarding worthwhile improvement trends in shaft construction methods.

26649 (LBL—13500, pp 3.37-3.39) **Performance measurements for residential air-to-air heat exchangers.** Fisk, W.J.; Archer, K.M.; Bitton, R.; Boonchanta, P.; El-Adawy, B.; Haynes, R.; Hollowell, C.D.; Roseme, G.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

Results are summarized from measurements of effectiveness on five models of residential heat exchangers. Data describing the fan performance of two of these heat exchangers are also presented. The fan power consumption of residential heat exchangers ranged from 0.4 to 2.1 watts per m^3/h of ventilation air. Fan power requirements can be reduced by using efficient fans and fan motors, minimizing the resistance to air flow through heat exchangers and duct systems, and using fan speed instead of damper valves for the control of air-flow rates. (PSB)

26650 **(MLM—3142) Application of reel-to-reel processing to slapper detonator fabrication.** Schurman, W.R. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 10 Apr 1984. Contract AC04-76DP00053. 33p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010669.

A unique line of reel-to-reel processing equipment is being developed to fabricate an integral detonator/cable assembly. A wide variety of custom designed reel-to-reel processing and assembly equipment supports this in-house capability at Mound. Processes have been established to manufacture the major slapper detonator components (bridges and cable-conductors), and most of the major operations can be performed on reels of 35-mm wide flexible circuit materials. This is possible because the images are placed in-line along the length of the film. Design concepts that show how the reel-to-reel approach could be extended to nearly all assembly operations have been established. These concepts provide for the fabrication of different detonator designs with minimal tooling changes.

26651 **(N—8411349) Optimized He 2 cooling systems for space application. Behavior and handling of superfluid helium at G 0, phase 1. Final Report, Sep. 1981.** Denner, H.D.; Klipping, G.; Lueders, K.; Schotte, K.D.; Schotte, U.; Szuecs, Z.; Ruppert, U. (Freie Univ. Berlin (Germany, F.R.)). Jun 1983. 56p. (In German). (BMFT-FB-W—83-008; ISSN—0170-1339). NTIS, PC A04/MF A01.

Increased reliability of He2 cooling systems for space applications is considered. An active phase separator (APS) with annular flow gap of variable length which allows variation of the cooling capacity over a wide range, developed for zero-g tests is described. Helium-tight electrical leadthroughs, a displacement transducer for low temperature application, a ball closure for use in combination with the APS, and gas/liquid detectors were developed. For temperature and liquid level measurement in narrow slits in laboratory as well as flight experiments, temperature sensors were developed. Three thickness measurement methods for He2 films are proposed: optical (1/10 000 to 1/100 mm), crystal (1/10 to the 7th power to 1/10 mm) and capacitive (1/10 to the 6th power to some mm).

26652 **(N—8411350) Electroforming of complicated structures for the nuclear and aerospace industry.** Suchentrunk, R. (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.)). 1983. 20p. Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, Germany, F.R.

Presented at AES intern. electroforming/deposition forming symp., Los Angeles, 23-24 Mar 1983.

Fabrication of concentrators for 100 kW solar energy plants production of water cooled screens, boxes and targets for nuclear fusion experiments with the Joint European Torus large scale fabrication of erosion protection shapes for airplanes and fabrication of compact wind tunnel models by electroforming are discussed. Composition of electroforming electrolytes (nickel, copper) bath parameters and process technology are described.

26653 **(ORNL/TM—8633) Safety analysis report for packaging: the ORNL DOT specification 6M - tritium trap package.** DeVore, J.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010616.

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The ORNL DOT Specification 6M—Tritium Trap Package was fabricated at the Oak Ridge National Laboratory (ORNL) for the transport of Type B quantities of tritium as solid uranium tritide. The package was evaluated on the basis of tests performed by the Dow Chemical Company, Rocky Flats Division, on the DOT-6M container, a drop test performed by the ORNL Operations Division, and International Atomic Energy Agency (IAEA) approvals on a similar tritium transport container. The results of these evaluations demonstrate that the package is in compliance with the applicable regulations for the transport of Type B quantities of tritium. 4 references, 8 figures.

26654 **(PNL—5043) Operating manual for water in hydrocarbon leak detector.** Robertus, R.J.; Sullivan, R.G.; Shannon, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010651.

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This Operating Manual includes the following sections: Water Detection; Leak Detection System; Instrument Features; Installation; Set-up and Calibration; Operation; and Service and Maintenance.

26655 **(UCRL—90049) Method of pipe whip and impact analyses.** Chun, R.C.; Chuang, T.Y. (Lawrence Livermore National Lab., CA (USA)). 21 Nov 1983. Contract W-7405-ENG-48. 14p. (CONF-840647—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84003897.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

We successfully reproduce one of the French pipe whip experiments with the computer code WIPS. The WIPS results are in excellent agreement with the experimental data and the French computer code TEDEL. This justifies the use of its pipe element in conjunction with its U-bar element in a simplified method of impact analyses.

26656 **(UCRL—90281) Draft standard guide for estimating the in-situ modulus of rock masses using the NX-borehole jack.** Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 20p. (CONF-840666—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006135.

From American Society for Testing of Materials meeting on rocks and soils; Philadelphia, PA, USA (1 Jun 1984).

The objective of this test is to estimate the in-situ modulus of a rock mass at various depths and orientations. Information on time-dependent deformation may also be obtained. The NX jack provides unidirectional pressure to the walls of an NX borehole (3 in. or 7.62 cm in diameter), by means of two opposed curved steel platens each covering a 90° sector, over a length of 8 in. (20.3 cm).

26657 **(UCRL—90509) Reliability analysis for stiff versus flexible piping.** Lu, S.C. (Lawrence Livermore National Lab., CA (USA)). 2 Mar 1984. Contract W-7405-ENG-48. 13p. (CONF-840632—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008325.

From Advances in probabilistic structural mechanics symposium; San Antonio, TX, USA (17 Jun 1984).

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A confirmatory piping reliability assessment for stiff versus flexible piping systems indicated that removing rigid supports tends, in general, to reduce thermal stress but to increase seismic stress in the pipe. As a result, piping design can be made more reliable by some reduction of rigid supports. We also observed that piping design using snubbers among support devices may not exhibit the intended reliability because snubbers often fail to perform the desired function. It was demonstrated that certain piping systems with snubbers removed actually exhibit higher reliability than do those of the original design.

26658 **Behavior of sustained high-current arcs on molten alloy electrodes during vacuum consumable arc remelting.** Zanner, F.J.; Bertram, L.A. (Sandia National Laboratories, Albuquerque, NM 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **11**: No. 3, 223-232(Sep 1983).

Vacuum consumable arc remelting is a casting process carried out in a vacuum with the aim of remelting the consumable electrode in such a way that the new ingot has improved chemical and physical homogeneity. The power which causes the melting is supplied by a vacuum arc burning between the electrodes. In order to determine the furnace partitions of electrical power and current, experiments were conducted on molten-faced round electrodes. The quasi-steady melt rate was determined for both horizontally opposed 15-cm-diameter Ni electrodes and for vertically suspended 40cm-diameter Inconel 718 electrodes. The cathode thermal power is directly proportional to the melt rate which, for the horizontally opposed electrode experiment, agrees to within 10 percent with the Ni breaker switch calorimetry measurements and with predictions from retarded potential analyzer plasma data. However, for the vertically suspended electrode experiments, the measured thermal power at the cathode is 50 percent higher than for nickel. When CO is introduced into the vertical alloy electrode system and electrode gap is increased, the cathode thermal power is reduced by approximately 50 percent. Furthermore, the electrode position measurements and observation of the ingot surface suggest that a concentrated arc is formed under these conditions.

26659 **Electric arc saw apparatus.** Deichelbohrer, P.R. (to Dept. of Energy). US Patent Application 6-473,180. 08 Aug 1983. 18p. Contract AC06-77RL01030.

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A portable, hand-held electric arc saw apparatus comprising a small frame for supporting an electrically conducting rotary blade which serves as an electrode for generating an electric arc between the blade and a workpiece of opposite polarity. Electrically conducting means are provided on said frame for transmitting current to said blade. A pair of freely movable endless belts in the form of crawler treads are employed to facilitate movement of the apparatus relative to the workpiece.

26660 **Flexural support member having a high ratio of lateral-to-axial stiffness.** Haas, W.M.B. (to Dept. of Energy). US Patent Application 6-507,189. 23 Jun 1983. 13p. Contract AC05-76OR02908.

A convoluted flexible support structure is provided which is capable of supplying a lateral to axial spring rate in excess of 1000 to 1. A support member in the form of a steel disc having a specified number of rather large radius, concentric convolutions and a thickness in the range of from about 0.01 to 0.02 inch has an axial stiffness of about 50 pounds/inch while the lateral stiffness is about 100,000 pounds/inch. The support member may be used to support a vibration device where the lateral motion of the vibrator must be highly restricted while providing relatively free axial displacement of about +-0.25 inch.

26661 **Response of containment vessels to explosive blast loading.** Karpp, R.R. (Los Alamos National Lab., NM); Duffey, T.A.; Neal, T.R. *Journal of Pressure Vessel Technology;* **105**: 23-27(Feb 1983).

The response of steel containment vessels to the blast loading produced by the detonation of high explosives is investigated by experiments, computations, and analysis. The vessels are thin-wall shell structures that are nearly spherical. All explosive charges are solid spheres, centrally initiated and centrally positioned within the vessels. Most of the work concerns vessels that contain, in addition to the explosive charge, air at ambient or reduced pressures. One-dimensional, Lagrangian, finite-difference calculations are used to study the blast phenomenon and the details of the loading pulse applied to the vessel wall. The results are verified by comparisons with pressure gage records. In addition, vessel response to the pressure loading is calculated by both finite-difference and finite-element computer codes. The two-dimensional motion, which occurs after significant wave interactions have taken place in the test vessels, can be simulated, with reasonable accuracy, by finite-element calculations.

26662 **Instability mechanisms and stability criteria of a group of circular cylinders subjected to cross-flow. Part 1: theory.** Chen, S.S. (Argonne National Lab., IL). *J. Vibr. Stress Reliab. Des;* **105**: 51-58(Jan 1983). Contract W-31-109-ENG-38.

A mathematical model is presented for a group of circular cylinders subject to cross-flow. It is found that there are two basic dynamic instability mechanisms: instability controlled by fluid damping and instability controlled by fluidelastic force. Approximate closed form solutions of the critical flow velocity for the two mechanisms are obtained based on constrained-mode analyses. The model has identified the key parameters in the stability criteria and their functional forms and resolved the controversy associated with the empirical stability criteria.

26663 **Niobium-titanius superconducting materials.** Larbalestier, D.C. (Dept of Metallurgical Engineering and Materials Science University of Wisconsin, Madison, WI 53706). pp 133-199 of Superconductor materials science. Foner, S.; Schwartz, B.B. New York, NY; Plenum Publishing Corp. (1981). (CONF-800839—).

From NATO advanced study institute superconducting materials-science and technology; Lisbon, Portugal (19 Aug 1980).

The present paper reviews the current state of knowledge of the metallurgical properties of the niobium-titanium and related alloys. Information on the physical properties is then presented, fol-

lowed by a discussion of the superconducting properties, where the questions of obtaining high critical current density and high upper critical field are highlighted. Some fabrication and industrial aspects of niobium-titanium are then explored and the review closes with a summary of future developments and new directions in the application of niobium-titanium and its related alloys.

26664 **Superconducting proximity effects for in situ and model layered systems. Metallurgy, fabrication, and applications.** Finnemore, D.K. (Ames Laboratory-USDOE and Department of Physics Iowa State University, Ames, IA 50011). pp 725-734 of Superconductor materials science. Foner, S.; Schwartz, B.B. New York, NY; Plenum Publishing Corp. (1981). (CONF-800839—). Contract W-7405-ENG-82.

From NATO advanced study institute superconducting materials-science and technology; Lisbon, Portugal (19 Aug 1980).

In situ composites, which may be suited for large scale magnets, have the drawback that the ac losses are higher than for mechanically produced multifilamentary wire. Model systems which illustrate the basic physics involved would help to develop a quantitative understanding of the proximity effect so that analytical expressions were available for design. Two essential features in the choice of model systems are the magnitude of the pair potential at the superconducting normal metal boundary, and the value of K^{-1} /SUB M/ . The Pb-Cd is chosen for a model system, and a variety of geometrical arrangements for various experiments prepared. The boundary conditions, the phonon spectral function, supercurrents through normal barriers, and flux entry fields are studied, and the implications of the findings for in situ composites given.

26665 **Metallurgy of continuous filamentary A15 superconductors. Metallurgy, fabrication, and applications.** Suenaga, M. (Metallurgy and Materials Science Division, Brookhaven National Laboratory, Upton, NY 11973). pp 201-274 of Superconductor materials science. Foner, S.; Schwartz, B.B. New York, NY; Plenum Publishing Corp. (1981). (CONF-800839—).

From NATO advanced study institute superconducting materials-science and technology; Lisbon, Portugal (19 Aug 1980).

Since the discovery of the "bronze process" many small-scale magnets have been successfully fabricated. Large-scale applications of these materials to magnets for magnetic fusion reactors and highenergy accelerators are being designed and tested. Also the manufacturing technology for these composites have been developed to the extent that fabrication of large quantities of these wires is now possible. Thus, it seems desirable to recapitulate the early history of the "bronze process" and to describe modifications to the process which have since followed. The metallurgical principles, which are involved in the process, are described including the kinetics of the compound growth, the effects of additives on the growth, etc. The superconducting properties of these compounds are also reviewed. In particular, the influence of metallurgical variables on the superconducting properties is examined in detail. In discussing the superconducting current densities in these compounds, limits in applicability of existing magnetic-flux-pinning models are also treated as well as methods for determining critical magnetic fields.

4203 Lasers

REFER ALSO TO CITATION(S) 26783, 27614

26666 **(CONF-8406104—1) High repetition rate production of picosecond pulses at wavelengths <250nm.** McDonald, D.B. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 4p. NTIS, PC A02; 3; GPO Dep. Order Number DE84008258.

From Topical meeting on ultrafast phenomena; Monterey, CA, USA (12 Jun 1984).

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In this paper we describe a laser system for generating picosecond pulses with wavelengths <250nm at a 5kHz repetition rate. Short pulses from a synchronously-pumped dye laser are amplified to a peak power >5MW in a dye medium pumped by a copper vapor laser. Nonlinear optical techniques can then be used to shift the wavelength well into the uv. The high repetition rate of the pulses is important for pump-probe picosecond spectroscopy. Other laser systems have generally fallen into one of two groups: one with large pulse energies at low repetition rates (>1MW at <100Hz) and one using very small pulses at high repetition rates (< 3 kW at >50MHz). The large pulse experiments can create a transient population large enough to change the sample absorbance considerably, but often unwanted nonlinear effects accompany the extremely high intensities created by squeezing a large number of photons into a pulse of few picoseconds duration. Lower intensities necessitate sensitive probing of the transient population with careful signal averaging. This need has led several research groups to develop the high repetition rate systems using lock-in amplifiers and/or extremely high frequency modulation with AM radio detection. The low powers of the high repetition rate systems severely limits the use of nonlinear optical techniques needed to obtain picosecond pulses with uv and vuv wavelengths. Tunable pulses with peak powers of greater than 1MW have been available for several years using Nd:YAG laser pumped amplifiers at 10 Hz repetition and more recently at 100Hz using excimer laser pumped amplifiers. In the system to be described here the amplified pulses provide the fundamental wavelength for second harmonic generation and for sum-frequency mixing to generate the third harmonic. Stimulated Raman shifting in liquids is also possible for the generation of probe wavelengths.

26667 **(LA-UR—80-3506) Particular applications.** Butcher, R.R. (Los Alamos National Lab., NM (USA)). 15 Oct 1980. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010034.

Portions are illegible in microfiche products; Lecture 11.

The topic of this lecture is particular applications of high voltage pulsed power. The first point of discussion is the magnetron load. The voltage vs current characteristic of the load is shown. The voltage increases to the point where the device breaks down, then it goes into a nearly constant glow voltage region as the current increases. When you drive the current hard enough, you get into a region that is called abnormal glow and then it eventually will go into an arc at which point the voltage goes to a low values the current increases. This is typical of a number of devices. Most gas loads exhibit behavior that is at least similar to this. The data presented have been taken on a krypton fluoride fast-discharge laser. Many interesting parameters can be calculated from voltage and current. Some circuit parameters can be derived from the data, and a digital computer can be used to check the results and perhaps to test circuit modifications for improved performance.

26668 **(LA-UR—84-1190) Inductively stabilized excimer lasers.** Sze, R.C. (Los Alamos National Lab., NM (USA)). Dec 1983. Contract W-7405-ENG-36. 7p. (CONF-831265—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011371.

From 6. international conference on lasers and applications; San Francisco, CA, USA (12 Dec 1983).

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The technique of inductive stabilization of rare-gas halide discharges have been shown to yield long pulse laser outputs. The 1% efficiency obtained for the miniature short pulsed devices are believed to be very good. Length scaling to improve the gain per round trip of the laser cavity should improve the peak power in the cavity and greatly improve the extraction efficiency. This work is presently in progress. The measurement of a saturation energy for electrical energy deposition gives an important design criteria for high efficiency lasers. This number is believed to be valid regardless of the time scale of the energy deposition.

26669 **(LA-UR—84-1384) XUV/VUV free-electron laser oscillator.** Goldstein, J.C.; Newnam, B.E.; Cooper, R.K.; Comly, J.C. Jr. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 12p. (CONF-840387—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011347.

From 2. topical meeting on laser techniques in the extreme ultraviolet; Boulder, CO, USA (5 Mar 1984).

It is shown, from computations based on a detailed theoretical model, that modest improvements in electron beam and optical mirror technologies will enable a free-electron laser, driven by an rf linear accelerator, to operate in the 50 to 200-nm range of optical wavelengths. 10 references.

26670 **(N—8411496) Frequency stabilization of carbon dioxide lasers.** Gustavsson, A.; Renhorn, I. (Research Inst. of National Defence, Linkoeping (Sweden)). May 1983. 84p. (FOA-C—30328-E1). NTIS, PC A05/MF A01.

Means of stabilizing CO2 lasers, especially stabilizing to an external heated CO2 cell or the ouptut power of the laser are discussed. The theory of external cell laser induced fluorescence of heated CO2 gas is compared with experiment. The transition probability is calculated from observed absorption measurements at different pressures and applied to LIF measurements. A computerized feedback system for frequency stabilization of the laser was designed and applied to a low pressure CO2 laser with good inherent stability. Frequency stability of the order 1 MHz is achieved.

26671 **(SAND—83-2306C) UV laser triggering of crowbars used in the Sandia lightning simulator.** Landry, M.J.; Brigham, W.P. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 13p. (CONF-8406100—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009064.

From International conference on lightning and static electricity; Orlando, FL, USA (22 Jun 1984).

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We have applied the techniques of ir and uv laser-triggered switching of gaps to crowbar switching two Marx generators, delivering ≧ 250 to 50 kA in small and large impedance loads. Crowbar switching delays of 0.08 to 0.28 μs were observed if the laser radiation arrived in the crowbar gap when its voltage was 44% of its maximum applied voltage or at 23 to 68% of its self-break voltage. We have successfully triggered a 5.0 cm crowbar gap with 35 mJ of $\lambda = 249$ nm radiation when filled with 80 psig of SF_6. Electrodes have operated with 40 Coulombs of charge for 47 shots without detrimental surface damage.

26672 **Inductively stabilized, long pulse duration transverse discharge apparatus.** Sze, R.C. (to Dept. of Energy). US Patent Application 6-528,509. 01 Sep 1983. 21p. Contract W-7405-ENG-36.

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An inductively stabilized, long pulse duration transverse discharge apparatus. The use of a segmented electrode where each segment is attached to an inductive element permits high-energy, high-efficiency, long pulsed laser outputs to be obtained. The apparatus has been demonstrated with rare gas halide lasing media. Orders of magnitude increase in pulse repetition frequency are obtained in lasing devices that do not utilize gas flow.

26673 **Injection-locking unstable resonator excimer lasers.** Bigio, I.J.; Slatkine, M. (Univ. of California, Los Alamos Nat'l. Laboratory, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **19**: No. 9, 1426-1436(Sep 1983).

The authors review the basic criteria for effective and efficient injection locking of high-power excimer lasers, and enumerate the various parameters of practical concern for experimental implementation. Various injection schemes are compared and the fundamental limitations of the process are covered. Corroborative experimental results are also reviewed, and applications made possible by injection locking are discussed.

26674 **Laser window with annular grooves for thermal isolation.** Warner, B.E.; Horton, J.A.; Alger, T.W. (to Dept. of Energy). US Patent Application 6-513,521. 13 Jul 1983. 18p. Contract W-7405-ENG-48.

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A laser window or other optical element which is thermally loaded, heats up and causes optical distortions because of temperature gradients between the center and the edge. A number of annular grooves, one to three or more, are formed in the element between a central portion and edge portion, producing a web portion which concentrates the thermal gradient and thermally isolates the central portion from the edge portion, producing a uniform temperature profile across the central portion and therefore reduce the optical distortions. The grooves are narrow and closely spaced with respect to the thickness of the element, and successive grooves are formed from alternate sides of the element.

26675 **Modified wide-band dye laser tunable over 5 cm^{-1} with 0.08 cm^{-1} bandwidth.** Bomse, D.S.; Keller, R.A. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 6, 977-978(May 1983).

A simple procedure using the Coherent 590 dye laser which yields a scan range at least five times greater than available with single frequency lasers is described herein. The laser line width obtained by this procedure is sufficiently narrow to suit many laboratory needs. The technique was used to measure the frequency of a commercial ring dye laser with the Burleigh wavemeter in the high resolution mode.

26676 **Streak camera measurement of tryptophan and rhodamine motions with picosecond time resolution.** Nordlund, T.M. (Univ. of Rochester, NY); Podolski, D.A. *Photochemistry and Photobiology;* **38**: No. 6, 665-669(1983). Contract AC02-76EV03490.

The authors have used a signal averaging laser (30 ps pulse)-streak camera system to measure fluorescence anisotropy decays of dyes in solution and protein tryptophan chromophores with picosecond time resolution. Emission polarization as a function of time can be measured directly and simultaneously for both polarization directions and stored in an optical multichannel analyzer. The corrected anisotropy is computed after background subtraction. Rotations of free dyes in solution (Sulforhodamine 101, tryptophan) and the temperature-dependent internal motions of human serum albumin (tryptophan emission) are displayed.

26677 **Highly efficient widely tunable subpicosecond double mode locked laser.** Yasa, Z.A.; Amer, N.M. (Lawrence Berkeley Lab., CA). *Optics Communications;* **42**: No. 4, 281-284(15 Jul 1982). Contract AC03-76SF00098.

A high average power (~150mW) subpicosecond (0.5 ps) passively double mode-locked dye laser is described. Two synchronized cw pulse trains are generated which are independently tunable over broad wavelength ranges (~600 A).

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 25273, 25299, 25960, 26662, 27238

26678 (CONF-830528—Vol.2, pp 1149-1155) **Calculation of temperatures using a HP-41 CV microcomputer.** Roy, J.C.; Fradin, J. (COGEMA, Velizy, France). Dec 1983. NTIS, PC A99/MF A01.

From 7. international symposium on packaging and transportation of radioactive materials; New Orleans, LA, USA (15 May 1983).

The accuracy of the results depends to a great extent on the modeling of the packaging. The more the structure of the packaging is complex, the less the modelling will be precise and the less accurate will be the results. However, where it is sufficient to prove that temperatures likely to develop within the packaging are lower than a calculated maximum, it is sufficient to carry out modelling such that it is certain that heat transfers in the model are worse than in reality. In this case, a very considerable amount of packaging can be calculated using the THERM program.

26679 **(N—8411447) Investigation of two-component two-phase channel flow with heat supply for application in inside cooled turbine blades. Final Report.** Dreyer, U. (Technische Hochschule Aachen (Germany, F.R.)). Oct 1982. 59p. (In German). NTIS, PC A04/MF A01.

The cooling efficiency of a water-air mixture in turbines was investigated. A one-dimensional phase separating calculation model was developed to determine the characteristics of a two-phase, two-component flow. An electrically heated flow channel for a

water-air mixture was built to measure the heat transfer coefficients for different influence parameters. A considerable heat transfer increase is found with water injection. The measurements show a strongly decreasing Nusselt number along the channel, and a strongly increasing wall temperature at the end of the channel which excludes this cooling method for turbine cascades. The investigations prove the essentially higher cooling efficiency of the mixture, the quantitative determination of the heat transfer behavior, and the possibility of practical utilization.

26680 **Experiments with an intrinsically irreversible acoustic heat engine.** Wheatley, J.; Hofler, T.; Swift, G.W.; Migliori, A. (Los Alamos National Lab., NM). *Physical Review Letters;* **50**: No. 7, 499-502(14 Feb 1983).

The general qualities of a type of thermodynamic engine that depends intrinsically for its operation on irreversible processes are set forth and demonstrated experimentally in the context of a thermoacoustic heat-pumping engine.

4205 Materials Testing

REFER ALSO TO CITATION(S) 25927, 25972, 25976, 26449, 26660, 26661

26681 **(AD-A—137156/6) Quality control and nondestructive evaluation techniques for composites. Part 4. Radiography - a state-of-the-art review. Final report 1 Dec 80-15 May 81.** Alberti, F. (Army Materials and Mechanics Research Center, Watertown, MA (USA)). Jun 1982. 83p. (AMMRC-TR—82-40). NTIS, PC A05/MF A01.

This report reviews and relates the procedures, variables and techniques for producing a quality radiograph to past and ongoing research aimed at improving the radiographic technique as a nondestructive evaluation method, with emphasis on composite material investigations. In particular, the report includes discussions of state-of-the-art techniques such as microradiography, stereoradiography, and neutron radiography. Fluoroscopy is discussed along with recent developments in filmless techniques of radiographic imaging, electronic image enhancement, and use of opaque additives and penetrants.

26682 **(CONF-840647—1) Experiments on tubes conveying fluid.** Jendrzejczyk, J.A.; Chen, S.S. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 34p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84004031.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Tests are conducted for tubes conveying fluid for six types of support conditions. The objectives are to understand the dynamic characteristics of such systems for different support conditions and to examine the transition from one instability mechanism to another.

26683 **(IS—4836) Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.** (Ames Lab., IA (USA)). 1983. Contract W-7405-ENG-82. 172p. NTIS, PC A08/MF A01. Order Number DE83016795.

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Separate abstracts were prepared for the papers published in the following areas: (1) Application of Ultrasonic Quantitative Nondestructive Evaluation to Radio Frequency System Window Problems, (a) Improvements in Probability of Detection and (b) Sizing of Internal Flaws in Bore and Web Geometries; (2) Electromagnetic Detection and Sizing; (3) New Technical Opportunities; and (4) New Flaw Detection Techniques.

26684 (IS—4836, pp 1-9) **Ultrasonic flaw detection in turbine rotor component web geometries.** Thompson, R.B.; Gray, T.A. (Ames Lab., IA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to determine configurations of ultrasonic detection systems which promise high reliability of detection of cracks in turbine rotor component webs. This task was initiated in FY 1982 to provide a computer simulation approach for evaluating ultrasonic detection systems in order to identify optimal configurations for detecting cracks in web regions of turbine rotor disks. The associated computer software was based upon a measurement model which relates absolute scattering amplitudes to measured signals obtained in practice in an approximate but absolute fashion. The effects of transducer aperture, frequency, position and orientation, transmission through a liquid-solid interface, the size, shape, position and orientation of the crack, and properties of the base material are included in this model.

26685 (IS—4836, pp 11-21) **Ultrasonic flaw detection and sizing in turbine rotor component bore geometries.** Elsley, R.K. (Rockwell International Science Center, Thousand Oaks, CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The purpose of this task is to experimentally and theoretically study the detection and sizing of flaws located below curved surfaces. This type of measurement geometry arises frequently in nondestructive evaluation (NDE), including in the inspection of rotor components in Air Force turbine engines. The increasing performance requirements that are being placed on these components require improved NDE techniques which can not only detect but also characterize flaws on the order of 0.5 mm across. It is the goal of this task to provide a science base for making such measurements.

26686 (IS—4836, pp 25-40) **Experimental determination of grain noise and crack inversion parameters.** Ahlberg, L.A.; Tittmann, B.R. (Rockwell International Science Center, Thousand Oaks, CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The work reported here is part of a program on flaw detection in turbine rotor components. The objective is to determine the probability of detecting non-surface breaking fatigue cracks near the bore hole surfaces of an air-craft engine disk with the aid of ultrasonic techniques. The specific objectives of this task are to experimentally determine parameters needed for two goals; one of these is the development of measurement models which include the ultrasonic characteristics of a commonly used super powder metallurgy alloy, IN-100; the other is the development and verification of inversion procedures for quantitatively determining shape, size and orientation of internal cracks. The approaches, results obtained thus far, and plans for further work are discussed.

26687 (IS—4836, pp 41-53) **Probability of detection.** Fertig, K.W.; Richardson, J.M. (Rockwell International Science Center, Thousand Oaks, CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to develop probability of detection (POD) algorithms for the ultrasonic inspection of the interior of metals. This work is an extension of that started in FY 1982 wherein various ultrasonic inspection schemes were evaluated through comparison of their POD and operating characteristic curves for the case of detection of radially oriented planer cracks interior to a specimen with bore-like geometry (i.e., cylindrically curved front surface).

26688 (IS—4836, pp 55-56) **Simulated cracks.** Buck, O. (Ames Lab., IA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is twofold: (1) to design and produce a series of specimens with small bulk defects suitable for obtaining information on detectability of true small defects in turbine disks; and (2) to produce a specimen containing a simulated partially closed fatigue crack and to perform acoustic measurements to study the effects of partial closure on scattering.

26689 (IS—4836, pp 57-64) **Direct and inverse methods for scattering by cracks at high frequencies.** Achenbach, J.D. (Northwestern Univ., Evanston, IL). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

In work on this project, two analytical methods have been developed to map the edge of a crack by the use of data for diffraction of elastic waves by the crack-edge. The methods are based on elastodynamic ray theory and the geometrical theory of diffraction, and they require as input data the arrival times of diffracted ultrasonic signals. The first method maps flash points on the crack edge by a process of triangulation with the source and the receiver as given vertices of the triangle. By the use of arrival times at neighboring positions of the source and/or the receiver, the directions of signal propagation, which determine the triangle, can be computed. This inverse mapping is global in the sense that no a-priori knowledge of the location of the crack edge is necessary. The second method is a local edge mapping which determines planes relative to a known point close to the crack edge. Each plane contains a flash point. The envelope of the plane maps an approximation to the crack edge.

26690 (IS—4836, pp 65-66) **Born sizing in cylindrical and planar geometries.** Rose, J.H. (Ames Lab., IA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objectives of the task are (1) to evaluate the effects of diffraction corrections on the sizing of cracks in the plate and bore hole geometries; (2) to determine certain optimal features of transducers for use with the inverse Born approximation (IBA); and (3) to develop the utility of the IBA in sizing near-surface flaws. Major progress has resulted in a general computer program for the diffraction corrections in cylindrical geometry. The developed code allows the straightforward solution of non-normally incident beam in both the plate and bore-hole geometries. These results required the extensive development of both numerical and analytical methods, which resulted in the above-mentioned computer program.

26691 (IS—4836, pp 67-68) **Ultrasonic scattring from flaws near surfaces.** Varadan, V.V.; Varadan, V.K. (Ohio State Univ., Columbus). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of the program is to provide analytical and computational results that will aid in understanding the ultrasonic response from near surface flaws. In the past year a T-matrix formulation was developed to study the scattering of ultrasonic waves from near surface flaws when the part being examined is immersed in water. The analytical problem is that of a flaw embedded near the interface of joined fluid-solid half spaces.

26692 (IS—4836, pp 69-77) **Ultrasonic sizing of cracks in web geometries.** Gray, T.A.; Thompson, R.B. (Ames Lab., IA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to evaluate sizing algorithms for cracks in turbine rotor component web geometries. The purpose of this task is to evaluate three crack sizing algorithms: (1) inverse Born approximation, (2) inverse Kirchhoff approximation, and (3) $ka \sim 1$ resonance method.

26693 (IS—4836, pp 79-82) **Probe-flaw interactions and inversion processes.** Auld, B.A. (Stanford Univ., CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objectives of this research for the current period are: (1) extension to the case of an arbitrary nonuniform excitation the special case of inversion theory developed last year; (2) to perform multifrequency measurements on a variety of fabricated flaws, using the Fortunko bridge circuit; (3) to perform the inversion algorithms from (1) on the measurements of (2) as an experimental test of the theory and procedures; and (4) to perform measurements by the field perturbation method of the field distributions of a number of the candidate probes for the program.

26694 (IS—4836, pp 83-89) **Optimum design of eddy-current systems.** Bahr, A.J.; Martinez, J.R. (SRI International, Menlo Park, CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to determine the eddy-current flaw-detection system that offers maximum detection probability and sizing capability for a 0.015-in.-long, 0.007-in.-deep surface crack in a bolt-hole geometry. In work conducted last year, system and probe-flaw interaction models were combined with statistical detection theory, and the statistical operating characteristics of a system using a coil probe undergoing one-dimensional lift-off were analyzed. These calculations showed that there exists an optimum range of operating frequencies for detecting a specific flaw, and suggested the definition of two figures of merit for comparing eddy-current probes. Based on these calculations, several candidate probes were identified for possible use in a system optimized for detecting the target flaw. The work planned for this year is aimed at generalizing the statistical detection model to incorporate the effects of surface noise, flaw orientation and distribution, a wider variety of probe motion, filtering, and repeated (e.g., multi-frequency) measurements. In addition, the possibility of using a detection algorithm other than simple thresholding, as well as the effect of the detection statistics on inversion, will be considered.

26695 (IS—4836, pp 91-96) **Evaluation of an eddy-current tape-head probe.** Watjen, J.P.; Bahr, A.J. (SRI International, Menlo Park, CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to evaluate and characterize a new type of eddy-current probe based on ferrite tape-head technology. This evaluation includes performance comparisons with several types of conventional commercial probes.

26696 (IS—4836, pp 97-103) **Electric current perturbation techniques.** Beissner, R.E. (Southwest Research Inst., San Antonio, TX). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

Our general objective for the current year is to extend a mathematical model of the electric current perturbation (ECP) method to include the effects of transmitter and sensor geometry on ECP flaw detection. This includes calculations of: (1) the response function for a differential sensor that is not symmetric with respect to the normal to the specimen surface; (2) flaw induced current perturbations for non-uniform incident currents; and (3) the effects of probe liftoff and wobble on sensor response.

26697 (IS—4836, pp 105-108) **Probe and sample preparation.** Rummel, W.D. (Martin Marietta Corp., Denver, CO). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objectives of this portion of the eddy current project work are: (1) to select and characterize typical (commercially available) eddy current probes for use in experimental evaluations of probability of detection models; (2) to prepare and characterize controlled low cycle fatigue cracked specimens for use in generating crack response data; and (3) controlled probe/crack interaction studies to generate and document crack response distributions and noise response distributions.

26698 (IS—4836, pp 109-122) **Effect of surface and bulk parameters (typical of cast material) on flaw detection and sizing.** Adler, L.; Fitting, D.; Lewis, K. (Ohio State Univ., Columbus). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The main activities of our research during the last six months are summarized as: (1) preparation of aluminum cast samples; (2) cast surface studies; (3) cast volume studies; and (4) appli-

cation of Born inversion algorithms to size defects in aluminum cast materials. A detailed discussion of our results is presented.

26699 (IS—4836, pp 123-131) **Porosity estimation in composites.** Kak, A. (Purdue Univ., West Lafayette, IN). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

In the oblique incidence approach to porosity estimation, a graphite-epoxy composite is illuminated at off normal angles in such a manner that the reflected returns from the fibers are in directions away from the illuminating transducer. Since the scattered returns from porosity tend to be more omnidirectional than the fiber returns, there is a larger received signal in the presence of porosity.

26700 (IS—4836, pp 133-141) **Preparation of internal crack samples and ultrasonic measurements in composites.** Hsu, D.K. (Colorado State Univ., Fort Collins). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

This task consists of two separate although not unrelated subtasks. The work on the fabrication of internal crack samples of plastic materials has been completed and results are presented. Work on ultrasonic measurements in composites is under way and progress to date is reported.

26701 (IS—4836, pp 143-149) **Characterization of surface cracks using a laser probe.** Jungerman, R.L.; Khuri-Yakub, B.T.; Kino, G.S. (Stanford Univ., CA). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

This paper discusses the pulsed laser mode of surface crack characterization, the theory of acoustical displacement near surface defects, and plans for future research efforts.

26702 (IS—4836, pp 151-155) **Evaluation of photoacoustic microscopy for fatigue crack detection.** Thomas, R.L. (Wayne State Univ., Detroit, MI). 1983. NTIS, PC A08/MF A01.

In Interdisciplinary program for quantitative nondestructive evaluation. Semi-annual report, October 1, 1982-February 28, 1983.

The objective of this task is to determine the limits of resolution of scanning photoacoustic microscopy (SPAM) for crack detection in metals, both experimentally and theoretically and to determine the feasibility of applying SPAM to the detection of cracks on the inner surface and subsurface of a bolt hole. Results to date are reported.

26703 (LA-UR—83-3422) **New experimental techniques with the split Hopkinson pressure bar.** Frantz, C.E.; Follansbee, P.S.; Wright, W.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 28p. (CONF-840653—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84003818.

From 8. international conference on high energy rate fabrication; San Antonio, TX, USA (17 Jun 1984).

The split Hopkinson pressure bar or Kolsky bar has provided for many years a technique for performing compression tests at strain rates approaching 10^4 s^{-1}. At these strain rates, the small dimensions possible in a compression test specimen give an advantage over a dynamic tensile test by allowing the stress within the specimen to equilibrate within the shortest possible time. The maximum strain rates possible with this technique are limited by stress wave propagation in the elastic pressure bars as well as in the deforming specimen. This subject is reviewed in this paper, and it is emphasized that a slowly rising excitation is preferred to one that rises steeply. Experimental techniques for pulse shaping and a numerical procedure for correcting the raw data for wave dispersion in the pressure bars are presented. For tests at elevated temperature a bar mover apparatus has been developed which effectively brings the cold pressure bars into contact with the specimen, which is heated with a specially designed furnace, shortly before the pressure wave arrives. This procedure has been used successfully in tests at temperatures as high as 1000°C.

26704 (SAND—84-0432) **Development of a high-pressure quasi-isentropic plane wave generating capability.** Barker, L.M.; Scott, D.D. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011619.

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A new technique for generating quasi-isentropic compressive waves in condensed materials is described. The method makes use of a pillow impactor to cushion the impact that creates the wave. Uniaxial strain compression is produced for ease of data analysis, and the method can be used to generate waves over a very wide range of peak stresses, including multi-megabar waves. A number of facets of the technique are discussed, such as input wave rise-times, simultaneous shock-up concepts, pillow spall tendencies, and data analysis techniques. Using the new technique on aluminum has resulted in new experimental support for recent theories on localized shear heating during dynamic loading. Finally, the fabrication of the pillow impactors is described in some detail, and pillow quality control testing is discussed.

26705 (SC-TM—640931) **Dynamics of mechanical systems.** Murfin, W.B. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1964. Contract AC04-76DP00789. 46p. NTIS, PC A03. Order Number DE84009784.

Paper copy only, copy does not permit microfiche production.

The solutions to the three principal problems involving dynamics of mechanical systems are described, namely: (1) transient response for arbitrary input; (2) sinusoidal vibration response; and (3) the normal model problem. Computer programs are given for the solutions.

26706 **Finite element modeling of ultrasonic inspection of weldments.** Dewey, B.R.; Adler, L.; Oliver, B.F.; Pickard, C.A. (Univ. of Tennessee, Knoxville, TN). pp 257-270 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

High performance weldments for critical service applications require 100% inspection. Balanced against the adaptability of the ultrasonic method for automated inspection are the difficulties encountered with nonhomogeneous and anisotropic materials. This research utilizes crystals and bicrystals of nickel to model austenitic weld metal, where the anisotropy produces scattering and mode conversion, making detection and measurement of actual defects difficult. Well characterized samples of Ni are produced in a levitation zone melting facility. Crystals in excess of 25 mm diameter and length are large enough to permit ultrasonic measurements of attenuation, wave speed, and spectral content. At the same time, the experiments are duplicated as finite element models for comparison purposes.

26707 **Effects of microstructure on the speed and attenuation of elastic waves: formal theory and simple approximations.** Gubernatis, J.E.; Domany, E. (Theoretical Division, Los Alamos National Laboratory, Univ. of California, Los Alamos, NM 87545). pp 833-851 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper attempts to develop a more unified theory of the attenuation of an elastic wave and its relation to microstructural statistics by following a first principle approach, using developments from other multiple scattering problems and adapting them to the elastic wave case. Several expressions are derived which establish a hierarchy for the statistical information required to evaluate the series. Several simple approximations are presented. The validity of the commonly made assumption that alpha = n-sigma is clarified, and the effective speed is computed. Three basic conclusions are reached: the attenuation exhibits a nearly universal behav-

ior when appropriately scaled; the phase velocity is less sensitive than the attenuation to variations of k /SUB a/ o and c (as specified), and both v and alpha are insensitive to modest variations in pore radius.

26708 **Elastic wave scattering from multiple voids (porosity).** Thompson, D.O.; Rose, J.H.; Thompson, R.B.; Wormley, S.J. (Ames Laboratory, USDOE Iowa State Univ., Ames, IA 50011). pp 867-882 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes the development of an ultrasonic backscatter measurement technique which provides a convenient way to determine certain characteristics of a distribution of voids (porosity) in materials. A typical ultrasonic sample prepared by placing the "frit" in a crucible in an RF induction heater is shown. The results of the measurements were Fourier transformed into an amplitude-frequency description, and were then deconvolved with the transducer response function. Several properties needed to characterize a void distribution are obtained from the experimental results, including average void size, the spatial extent of the voids region, the average void separation, and the volume fraction of material contained in the void distribution. A detailed comparison of values obtained from the ultrasonic measurements with visually determined results is also given.

26709 **An inverse problem in viscoelasticity.** Thigpen, L.; Bonner, B.P.; Hedstrom, G.W. (Lawrence Livermore National Laboratory, Livermore, CA 94550). pp 897-906 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper characterizes the mechanical response of a viscoelastic material by means of low strain creep and creep recovery experiments. The principle objective is to present an example of the numerical inversion of the first kind integral equation for the distribution functions using a method of constrained regularization. The constrained regularization method is applied to invert spectra from the creep function for a commercial grade polymethyl-methacrylate specimen. Some background information on the formulation of the integral equation for the distribution function is given. The demonstrated technique provides significant improvement over more direct methods of solution such as the method of Shapery, particularly when the data are noisy.

26710 **Inverse ray tracing in anisotropic elastic solids.** Norris, A. (Northwestern Univ. Evanston, IL 60201). pp 907-922 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The problem of inverse ray tracing in a homogeneous anisotropic elastic solid is considered, with specific application to crack sizing. The data is assumed to be in the form of travel times of diffracted ultrasonic signals between transducers positioned on an exterior surface of the body. Both pulse-echo and pitch-catch data are considered. First, it is assumed that the wave speeds are unknown and must be obtained as part of the inversion procedure. The specific problem of locating a crack tip in a two-dimensional geometry is investigated. It is found that travel time data on the exterior surface suffices to locate the crack tip only if the material is isotropic. If the material is anisotropic, we must be able to move the source and/or receiver in the direction normal to the surface. The same problem is considered with the source and receiver positioned in a surrounding isotropic material, e.g., a water bath. It is shown that the ray inversion is now possible only if the solid is isotropic, the problem being underdetermined for an anisotropic solid. Numerical results are presented for a synthetic experiment in which a finite crack is present in some anisotropic elastic solids. Next, the problem is considered when the speeds are known a-priori. It is shown that a crack edge can be mapped by a local approximation procedure.

26711 **The maximum entropy formulation of inverse problems of NDE.** Bevensee, R.M. (Lawrence Livermore National Laboratory Livermore, CA 94550). pp 937-948 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper introduces the Maximum Entropy method of resolving undetermined objects (flaws or inclusions), in three areas of research. First, synthetic aperture imaging to resolve three dimensional flaws with the aid of selective back projection is studied, and has been successful in the case of the 50 MHZ imaging system at Stanford. Second, scattering from anomalies according to the inhomogenous Fredholm integral equation of the second kind is presented, and cases of ME resolution of theta by a "raypath" approach, and from the "radiating source" viewpoint are studied. An example of the radiating source ME method is given. Finally, third, ultrasonic flaw characterization by the boundary integral equation method is studied. In general, the Maximum Entropy method can be employed with reasonable effort to obtain a "most probable" solution to an inversion problem with a minimum number of assumptions.

26712 **The Inverse Born Approximation: Exact determination of shape of convex voids.** Rose, J.H.; Opsal, J.L. (Ames Laboratory Iowa State Univ. Ames, IA 50011). pp 949-960 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The Inverse Born Approximation (IBA) to the elastic wave inverse scattering problem is known to give highly accurate results for the shape of complex voids. In this paper we present an argument demonstrating that the IBA is, in fact, exact for determining the size, shape and orientation of a wide class of these scatterers given infinite bandwidth and unlimited aperture information. Essentially, argument demonstrates how the IBA algorithm picks out the singular contribution to the impulse response function and correctly relates it to the shape of the scatterer. Some specific examples will be used to illustrate the more intuitive aspects of the discussion.

26713 **Ultrasonic 3-D reconstruction of inclusions in solids using the Inverse Born Approximation.** Hsu, D.K.; Rose, J.H.; Thompson, D.O. (Physics Dept. Colorado State Univ. Fort Collins, CO 80523). pp 995-1018 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This article discusses various steps taken to prepare the intermediate frequency data protocol essential to the design of a composite transducer which will be able to utilize alogrithms to effectively determine parameters of flaws at the intermediate wavelength end of the spectrum. The characterization of the Inverse Born Approximation, begun elsewhere, is continued. This algorithm is used to size a set of several different types of inclusions, using pitch-catch as well as pulse-echo data. The ability of the 1-D IBA to provide information on the flaw's shape and orientation is also studied. A reconstruction technique for determining the size, shape, and orientation of an inclusion flaw in terms of an equivalent ellipsoid is studied. The validity of the ellipsoidal reconstruction technique is tested by applying it to the degenerate case of a spherical inclusion, such as a prolate spheroidal inclusion, and to an oblate spheroidal void in titanium, to a near-surface inclusion, and to a flat circular crack.

26714 Evaluation of photoacoustic microscopy fatigue crack detection. Grice, K.R.; Favro, L.D.; Kuo, P.K.; Thomas, R.L. (Dept. of Physics Wayne State Univ. Detroit, MI 48202). pp 1019-1028 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper evaluates the technique of scanning photoacoustic microscopy (SPAM) for the detection of fatigue cracks in metal alloys, and describes an experimental arrangement for SPAM measurements on the inner surface of a cylindrical bolt hole. The aluminum fatigue crack specimens are described, and optical and photoacoustic micrographs of the specimens are given. Some results from theoretical calculations for tilted cracks are presented and compared with experimental data. A rotary scanning stage is constructed in order to test the feasibility of applying SPAM to the detection of fatigue cracks on the inner surface of a cylindrical bolt hole, and the SPAM magnitude perspective plot which results from the test is shown.

26715 Progress on ultrasonic flaw sizing in turbine engine rotor components: bore and web geometries. Rose, J.H.; Gray, T.A.; Opsal, J.L.; Thompson, R.B. (Ames Lab., USDOE Iowa State Univ. Ames, IA 50011). pp 1065-1096 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper discusses two classes of problems which arise in the sizing of defects in aircraft jet engine components, the adaptation of current 1-D inversion algorithms to the case of cracks, and the effects of focussing, diffraction, and refraction on sizing estimates. Several methods which use the intermediate frequency information are suggested, including the 1-D version of the Inverse Born Approximation, a similar algorithm based on the Kirchoff approximation, and a method based on the existence of a strong peak in the scattering amplitude for a penny shaped crack at specified parameters. The effects of focussing, diffraction, and refraction on the 1-D IBA for plate geometries, weakly spherically curved surfaces, and weakly cylindrically curved surfaces are discussed. Finally, the use of IBA with a spherically focussed transducer, which allows a simple correction to the IBA for near-field effects, is considered.

26716 Classification of NDE waveforms with autoregressive models. Melton, R.B. (Pacific Northwest Laboratory Richland, WA 99352). pp 1117-1126 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC06-76RL01830.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes a new approach for classifying NDE waveforms by constructing a set of matched filters based on the parameters of autoregressive models of the data. The background of autoregressive models is reviewed, and it is shown how such a model may be viewed as a recursive filter which can process waveform data serially. An experiment with computer generated data that establishes the feasibility of the hypothesized approach is given, and related to conventional recognition pattern. The approach is then applied to acoustic emission real data. On the computer generated data the procedure was shown to compare extremely well with conventional pattern recognition, but on real data the procedure did not perform as well.

26717 Rough surface effects of aluminum castings on ultrasonic sizing algorithms. Lewis, K.; Adler, L.; Fitting, D. (Dept. of Welding Eng. The Ohio State Univ. Columbus, OH 43210). pp 1127-1140 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Because the Born inversion algorithm for ultrasonic sizing depends on the noise level and the bandwidth of the spectral information available, the required bandwidth of experimental examples are obtained, and the effect of rough surfaces on the samples is considered. In order to estimate the error which one can expect a rough surface to introduce into the inversion algorithm, the experimental spectra acquired previously through smooth surfaced samples are perturbed by multiplying the amplitude spectra by the spectrum of the rough surface of the aluminum cast. These new spectra were then put into the inversion and the new estimates compared to the previous results. The comparison of the estimated roughness was found to be in good agreement with the measured value.

26718 On the effects of a finite aperture on the Inverse Born Approximation. Kogan, V.G.; Rose, J.H. (Ames Laboratory-USDOE Iowa State Univ. Ames, IA 50011). pp 1141-1158 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This study develops a method for calculating the finite aperture characteristic function for weakly scattering flaws with the Inverse Born Approximation. The aperture limited characteristic function is defined for a spherical flaw with an aperture described by a right circular cone. Analytical results are also obtained for a weak spherical inclusion, and a penny shaped crack. The general results are: the value of the characteristic function gamma is constant in the interior of the flaw, but reduced in value; the discontinuity at the boundary of the flaw occurs over the "lighted" portion of the flaw; this discontinuity is contrasted by a region where gamma is negative; and, finally, new non-physical discontinuities and non-analyticities appear in the reconstructed characteristic function.

26719 Evaluation of a novel eddy-current probe for detecting cracks inside and at the edges of holes. Watjen, J.P.; Bahr, A.J. (SRI International Menlo Park, CA 94025). pp 1187-1202 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper evaluates a ferrite material modified floppy disk tape head crack detector. This type of probe has two advantages: ferrite material concentrates most of the available magnetic field in the gap, and the active part of the prove is nonconductive and can therefore be placed directly on the sample. The characteristics and capabilities of this probe are tested by comparing their measured sensitivities and lift-off parameters with those produced by a conventional coil probe. Examples of the flaw and lift-off responses as displayed on storage oscillope are shown. The dependence of the flaw response on probe orientation is also studied. The extent of the magnetic leakage field side effects produced outside the gap region of the tape head probe is mitigated by using either of two different designed and tested differential tape head configurations. In conclusion, the ability of the probes to concentrate their magnetic fields in a small region results in high flaw sensitivity and good lift-off discrimination. The results presented here demonstrate that tape head probes can detect small EDM slots that break the edge of a flat plate.

26720 The change in impedance of a single-turn coil due to a flaw in a coaxial conducting cylinder. Zaman, A.J.M.; Gardner, C.G.; Long, S.A.; Richards, W.F. (Dept. of Electrical Engineering Univ. of Houston, Houston, TX 77004). pp 1219-1236 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The results of a previous investigation in which an analytical expression was derived for the change in complex impedance between an ideal one-turn coil surrounding and coaxial with an infinitely long conducting cylinder are used to calculate the change in impedance of a single-turn coil surrounding a cylindrical conducting core due to a small flaw at an arbitrary location inside the cylinder. The basic geometry of the problem is described. The effect on coil impedance due to the variation in the radial location of the flaw is investigated by plotting the real and imaginary part of the depth factor versus the normalized flaw depth. A first order approximation is derived for the complex change in impedance due to the flaw located at an arbitrary position. This change is seen to depend on the depth and axial position of the flaw as well as the geometrical and physical parameters of the coil and the core.

26721 **Electric current perturbation calculations for half-penny cracks.** Beissner, R.E.; Sablik, M.J.; Teller, C.M. (Southwest Research Inst. San Antonio, TX). pp 1237-1254 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This study developes a mathematical model for the electric current perturbation (ECP) flux distribution for a half-penny crack, determines the degree of validity of the model through comparison with experimental data, and develops a theory of sizing relationships for half penny cracks. A solution from hydrodynamics is used to calculate the current flow around a half-penny crack. The distance (r) from the crack to the sensor is assumed to be large compared to the crack radius (b), and this approximation is used to simplify volume integrals. Then a multipole expansion of the vector potential is derived to calculate the corresponding change in flux density. The large r/b approximation is compared with experimental z-scans at various distances from the center of the crack and the results show good agreement. Comparisons of z-scans with higher order multipole calculations show a slight departure from experiment for large crack lengths. But as this trend appears to confirm the sizing relationships that have been established experimentally, it is concluded that for small half penny cracks the analytical model presented in this study provides a good account of both the detailed behavior of ECP signals and empirically determined sizing relationships.

26722 **Eddy current characterization of applied and residual stresses.** Junker, W.R.; Clark, W.G. Jr. (Materials Engineering Dept. Westinghouse R & D Center Pittsburgh, PA 15235). pp 1269-1286 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

An exploratory investigation was conducted to evaluate the applicability of state-of-the-art eddy current nondestructive evaluation techniques to the characterization of applied and residual stresses in structural steels. Eddy current response versus stress measurements were developed for ASTM Type A533B and A471 steels under tensile, bending and residual stress loading conditions. A "shrink fit" specimen was used to establish applicability to residual stresses. Results show that an eddy current approach can be used to provide an accurate quantitative measure of surface stresses. The technique can also be used to map surface stress contours. Details of the procedure are described along with the test results and proposed applications. Recommendations for further work needed to optimize and expand the technique are included.

26723 **Residual stress characterization by use of elastic wave scattering measurements.** Domany, E.; Gubernatis, J.E. (Los Alamos National Laboratory, Los Alamos, NM 87545). pp 1309-1326 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper demonstrates that elastic wave propagation in the presence of non-uniform residual stress can be viewed as a scattering problem. The basic picture in which an attempt is made to characterize the residual stress state by examining a scattering of a probing elastic wave propagating through the residual stress field is detailed. The basic equations for the deformation, residual stress state, and the motion of scattering are derived. Several examples of the wave motion in regions where the displacement gradients are homogenous are studied. This entails the acoustoelasticity effect, which is explained. To consider the scattering of an elastic wave from a single center of an inhomogenous state of residual stress, "misfit" problems are discussed, in particularly a hydrostatically-deformed spherical region. The longitudinal-longitudinal scattering cross section from the residual stress field associated with a spherical misfit region is shown. It is hoped that this interpretation can be used in various contexts, such as surface residual stress characterization.

26724 **Absolute determination of stress in textured materials.** Thompson, R.B.; Lee, S.S.; Smith, J.F. (Ames Laboratory, USDOE Iowa State Univ. Ames, IA 50011). pp 1339-1354 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A number of fundamental problems have prevented the widespread application of the ultrasonic acoustoelastic measurement of stress within the interior of an elastic body. This paper is concerned with the problem of differentiating stress induced velocity shifts from velocity shifts by microstructural variations. A theoretically proposed relationship between the velocity of two shear waves propagating in perpendicular directions, and the stress in the material may overcome the aforementioned problem. Three technical issues involved in the application of this relationship are studied: the correct interpretation of the predictions of the continuum theory, the determination of its applicability to engineering materials, and the identification of practical configurations whereby this effect could be used to measure stress in a structure of interest. The difference between a stressed and an anisotropic material is reviewed, the application of stress predictions to polycrystalline metals is discussed, and a practical measurement system to measure uniform stress in a rolled plate is proposed.

26725 **The use of the temperature dependence of ultrasonic velocity to measure residual stress.** Salama, K.; Narber, G.C.; Wang, J.J. (Department of Mechanical Engineering University of Houston, Houston, Texas 77004). pp 1355-1366 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The behavior of the temperature dependence of longitudinal ultrasonic velocity in type A533B steel in the presence of external as well as residual stresses has been investigated. In all measurements, the ultrasonic velocity in the vicinity of room temperature is found to vary linearly with temperature, and the slope of the linear relationship increases or decreases according to whether the stress is applied in tension or in compression respectively. The results also indicate that the temperature dependence of the velocity is a linear function of applied stress, and the slope of this linear relationship is the same for all specimens tested, and for both tensile and compressive stresses. These results are then used to obtain a relationship between the temperature dependence and residual stress in type A533B steel.

26726 Detection of strain induced microstructural changes in aluminum (6061-T6) using ultrasonic signal analysis. Thomas, G.H.; Emery, A.F.; Goods, S.H. (Acceptance Technology Division & Materials Science Div. Sandia National Laboratories Livermore, CA 94550). pp 1367-1380 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC04-76DP00789.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Because the presence of voids within a material due to the nucleation of cavities leads to ductility loss, an ultrasonic attenuation measurement technique is developed to indicate the presence of voids within a fabricated part prior to its use. The study seeks to correlate ultrasonic attenuation with void nucleation and growth in aluminum alloy (6061-T6). A protocol, data acquisition technique, reduction of data method, and measurement procedure are presented. Preliminary metallography indicates that voids appear in the specimen after approximately 5-8% strain. Thus, a relationship between ultrasonic signal attenuation and deformation of induced void formation in the test alloy is established.

26727 The use of acoustic signal attenuation in the examination of residual strains: Part B-- The use of experimentally derived acoustic strain correlations in the evaluation of residual strains and stresses. Emery, A.F.; Thomas, G.H. (Univ. of Washington Seattle, WA 98185). pp 1381-1388 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC04-76DP00789.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper studies an acoustic technique to estimate the residual stresses in complex situations which makes use of experimentally derived acoustic strain correlations. The problems in the usual methods which call for the use of this technique are discussed. The basic concepts of the approach are listed. In the method, one must calculate the mechanical history of the materials, estimate the signal attenuation by empirical correlation, and by scattering theory based upon internal damage models, and finally, compare the predicted and measured signal attenuation patterns. An agreement of the patterns implies a correctness of computations. In order to develop empirical correlations and an understanding of the internal microstructural damage models needed for step 2, a series of experiments are conducted. Attenuation profiles and patterns measured for the deformed system are derived.

26728 Ultrasonic determination of grain size in uranium. Brosey, W.D. (Union Carbide Corp., Nuclear Division Oak Ridge Y-12 Plant P.O. Box Y Oak Ridge, TN 37830). pp 1399-1410 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-26.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

An ultrasonic nondestructive testing technique has been developed at the Oak Ridge Y-12 Plant that takes an average grain size measurement through the thickness of the part. Ultrasonic grain size determination is based on the frequency dependent scattering of sound by grains of various diameters. The larger the grain size present in the part, the lower the frequency of sound that will pass through the part relatively unscattered. The transducer configuration for pitch-catch grain size measurement of uranium parts is shown. Other ultrasonic methods such as through transmission and contact shear are also discussed, but did not allow as broad a grain size spectrum, or attenuated the sound inconsistently. Using the pitch catch method, it was possible to determine the grain size of a uranium part to within plus or minus 1 ASTM grain size number with a 2-sigma accuracy.

26729 A portable high speed ultrasonic imaging system. Hildebrand, B.P.; Boland, A.J.; Davis, T.J.; Silta, R.R. (Spectron Development Laboratories, Inc. 1010 Industry Dr. Seattle, WA 98188). pp 1437-1454 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

In this paper the backward wave principle BWP of acoustical holography is described. The three steps in the holographic imaging process--data gathering, data processing, and image display- are discussed. The time-of-flight (TOF), broadband signal, and short coherent pulse modes of data gathering are reviewed. A typical matrix of complex numbers representing the phase and amplitude of the wavefront reflected by the object, which results from data gathering, is computed. A holographic process designed to image pipe buried up to one meter in soil using one-dimensional TOF holography, under investigation for the Gas Research Institute, is studied. Several figures show the various steps along the way to the final image, such as the experimental time-of-flight profile, and the experimental phase profile. A display mode which plots the image intensity in an isometric view is considered. All results in this paper were obtained with a prototype imaging computer soon to be available from Spectron Development Laboratories with preliminary specifications are given.

26730 The clamping force of heat shrinkable fittings. Rehbein, D.K.; Skillings, B.J.; Smith, J.F.; Thompson, D.O. (Ames Laboratory-USDOE Ames, IA). pp 1455-1466 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper researches the development of a nondestructive evaluation technique for the clamping force which is produced at a union during practical application on couplers of the phenomenon of alloys which has come to be known as "shape memory" (which is defined). Micrometer measurements, outside diameter and inside diameter measurements of six couplers are taken. A strain gage device used to measure inside diameters of coupled tubes is shown. A linear elastic approximation was used to estimate the relative interfacial stresses at coupler-tubing interfaces for the fullsized tubing. At all positions o.d. expansion and large initial outer tubing radius accompany an increase in stress. Another promising avenue for nondestructive evaluation of the relative interfacial stresses at coupler-tubing interfaces plots the normalized reflection coefficient vs. the calculated interfacial stresses at position A between the lands.

26731 Inversion of eddy current signals in a nonuniform probe field. Muennemann, F.; Auld, B.A.; Fortunko, C.M.; Padget, S.A. (Edward L. Ginston Laboratory Stanford Univ. Stanford, CA 94305). pp 1501-1526 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A simple analytical method for predicting the eddy current signal produced by a surface flaw when interrogated by a probe with spatially varying magnetic field is presented. An inversion technique which can systematically extract the position and overall dimensions of a surface breaking crack is constructed. A rectangular 3-dimensional flaw geometry simplifies the calculations. A broadband probe is developed, and multifrequency measurements necessary for inversion purposes made in experiments with it are described. The broadband eddy current bridge-probe configuration is schematicized. Experimental methods which determine the interrogating field geometry for any eddy current probe are described as well.

26732 Imaging and characterization of defects with digital signal processing of ultrasonic data. Barna, B.A.; Johnson, J.A. (EG & G Idaho, Inc. Idaho Falls, ID 83415). pp 1573-1596 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AC07-76ID01570.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This paper describes work on synthetic aperture focusing techniques (SAFT) and ultrasonic imaging. An algorithm developed in the literature is tested and extended to enhance images of a test sample with an extremely deformed surface. Images for SAFT processing without and with corrections for deviations of the surface from a horizontal plane are presented. The effect of extreme surface distortion is tested by a block which has had a concave area machined off. The difficulties encountered in attempting to account for surface deviations are discussed. A summary of the data includes raw data, SAFT-processed using an assumed flat surface, SAFT-processed using surface coordinates derived from the front surface echoes, and SAFT-processed using the actual surface coordinates. The application of SAFT to shear wave data without and with corrections for variations in the surface is also studied. Process images are improved in resolution and a decrease of position errors. Finally, surface mapping reconstruction techniques applied to a series of surface breaking cracks in steel bars are studied.

26733 A shear-wave transducer array for real-time imaging. Baer, R.L.; Kino, G.S. (Edward L. Ginzton Laboratory Stanford University Stanford, CA 94305). pp 1669-1678 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract AT03-81ER10865.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A contacting shear wave array for use with a real-time digital synthetic aperture imaging system is described. The relevant features and dimensions of the digital synthetic aperture imaging system are given. Shear waves are found to be excited in solid samples with greater efficiency than is possible with longitudinal waves. Aberrations are eliminated by using direct contact, and choosing a buffer rod composed of the same material and specimen. A 45 degree incidence increases sensitivity to cracks which run normal to the back surface of the array. Also, techniques developed to eliminate cross coupling can be used to double the depth resolution of the system. In sum, the images obtained with a shear wave array are significantly better than those obtained with longitudinal or surface wave arrays.

26734 Interferometric techniques using embedded optical fibers for the quantitative NDE of composites. Wade, J.C.; Claus, R.O. (EPRI NDE Center J.A. Jones Applied Research Co. P.O. 217097 Charlotte, NC 28221). pp 1731-1738 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

This work demonstrates the quantitative measurement of both stress and ultrasonic waves using fibers embedded in solid materials including composites. Quantitative optical fiber techniques which may be applied to NDE problems are reported on. First, a single mode Mach-Zehnder interferometric sensor is schematicized, and variations in pressure due to both continuous and pulsed acoustic and ultrasonic waves are measured. Measurements of ac or dc strain using a single sample fiber as the strain sensitive element are also studied. The detection of a two-dimensional stress field in a flat plate is reported. Finally, the qualitative multimode and the quantitative single mode fiber techniques are compared. The multimode fiber method depends upon the breakage of the fiber to indicate excessive strain, but the detection capability of quantitative single mode is not irreversibly destroyed during the measurement process.

26735 A computerized ultrasonic scanning bridge for defect imaging: composite materials. Boyd, D.; McDonald, W.; Simmons, A. (Lawrence Livermore National Laboratory Livermore, CA 94550). pp 1739-1748 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-48.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

An ultrasonic scanning bridge capable of positioning and orienting a transducer in an arbitrary manner using five axes is studied. Two Digital Equipment Corporation LSI 11/23 microcomputers are used. The ultrasonic equipment used for performing C-scan inspections includes an ultrasonic pulser-amplifier with a 4 channel peak height detector. The graphics hardware is a Peritek VCG-512Q graphics display with a medium resolution frame buffer. Ultrasonic inspection required for locating internal voids and delaminations in a graphite epoxy dome fabricated from twenty four plies of Thronel T300. Fiberite 934 tape laminate is described. Two angulation axes of the ultrasonic bridge were used to perform a raster scan. The inspection of several graphite domes shows that epoxy-rich regions, voids, and delaminations are easily detected. An accept/reject criteria was developed from a correlation of the ultrasonic inspection data with the destructive failure pressure.

26736 A computational tool for the design of ultrasonic systems. Wormley, S.J.; Lakin, K.M.; Thompson, D.O. (Ames Laboratory-USDOE Iowa State Univ. Ames, IA 50011). pp 1473-1486 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

As part of an effort to develop a composite, multiviewing ultrasonic transducer for flaw characterization, this paper discusses a computational tool that has been developed to select driver pulse shapes and transducer characteristics. Mason's model for an immersion transducer is the basis of model simulation. It is demonstrated that experimental results can be duplicated with the mode, and that it is useful in guiding selections of transducer pulse driver shapes in order to obtain extended bandwidth performance. Using the model in an inverse mode, that is, to specify the spectral bandwidth desired from the transducer and to determine the driver pulse required, is also considered.

26737 Noncontacting measurement of surface acoustic waves. Jungerman, R.L.; Bowers, J.E.; Khuri-Yakub, B.T.; Kino, G.S. (Edward L. Ginzton Laboratory Stanford University Stanford, CA 94305). pp 1749-1762 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

A new sensor for detecting surface acoustic waves is presented. Two fiber optic interferometric probes have been developed for application to nondestructive testing where the laser can be placed on an optical bench, but the probe can be used to scan the surface of a sample some distance away. The first probe, an adaptation of the heterodyne interferometric probe, required filtering and mixing that made the electronics too complicated. An all-fiber SAW sensor using single mode fiber components in place of bulk optic components was then developed and incorporated into a computer controlled scanning system. An example of the images obtainable from this system is given. The use of a lens system to increase the light and to provide a larger working distance between the sample and the optics is studied. The ability of the probe to detect defects in materials is examined. It is found that the probe is able to compensate for surface reflectance changes encountered while scanning rough surfaces, which makes the probe applicable to rough surfaces of practical interest.

26738 **Control for monitoring thickness of high temperature refractory.** Caines, M.J. (to Dept. of Energy). US Patent Application 6-443,988. 23 Nov 1982. 13p. Contract W-31-109-ENG-38.

This invention teaches an improved monitoring device for detecting the changes in thickness of high-temperature refractory, the device consists of a probe having at least two electrically conductive generally parallel elements separated by a dielectric material. The probe is implanted or embedded directly in the refractory and is elongated to extend in line with the refractory thickness to be measured. Electrical inputs to the conductive elements provide that either or both the electrical conductance or capacitance can be found, so that charges over lapsed time periods can be compared in order to detect changes in the thickness of the refractory.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 25555

26739 (LA—9911-C-Vol.1, pp 231-249) **Model of multiroom fire spread.** Tanaka, Takeyoshi. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

This paper presents a refined version of a mathematical model for predicting the hot gas flow induced by fires in multiroom structures. Two layer zone modeling approach is used in the mathematical formulation of the model. Some of the results of sample calculations of the model are also given for a couple of model structures.

26740 (LA—9911-C-Vol.1, pp 251-261) **Numerical and experimental investigation of simulated explosion effects on a flow network.** Tang, P.K.; Andrae, R.W.; Bolstad, J.W.; Gregory, W.S. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

The results of a numerical and an experimental study of a flow network subjected to a simulated explosion are presented. The numerical simulation uses a computer code called EVENT that predicts the response of a system under gas-dynamic stress conditions. The experiment uses a real flow system that is injected with a high-pressure gas. The results from these two are compared using a flow parameter such as pressure. It is concluded that the numerical calculation matches the result of the experiment quite well.

26741 (LA—9911-C-Vol.1, pp 283-300) **Theoretical and experimental study of flashover.** Hasemi, Yuji. Oct 1983. NTIS, PC A14/MF A01. (CSNI—83-Vol.1; CONF-830442—Vol.1).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

One approach to characterize flashover as a basis for deriving the quantitative measures to evaluate fire safety is shown. The onset of flashover is characterized as the appearance of the thermal instability in fire enclosure. The criteria for flashover to occur and the thermal state at the transition from early fire to flashover are formulated. Some assumptions used in the theory are verified by the experiments using a 0.40 x 0.40 x 0.40 m cubic model enclosure with methanol as the fuel. The experiments have also shown that a flashover would appear if the air induced to the enclosure is less than 5 times the stoichiometric air rate to the fuel.

26742 (LA—9911-C-Vol.2, pp 405-417) **HEPA filter loading by combustion products.** Fenton, D.L.; Gunaji, M.V.; Tang, P.K.; Martin, R.A. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Experiments have been conducted with 0.61m x 0.61m square commercially available HEPA (high efficiency particulate air) filters determining how airflow resistance varies with collected particulate mass. The combustion of two organic fuels - polystyrene and polymethylemethacrylate (PMMA) - at varying conditions generated the particulate material plugging the filters. Results indicate that the resistance ratio (actual filter resistance/initial filter resistance) correlates the filter mass gain for given conditions. For varying conditions, the airborne particulate mass concentration of particles greater than approximately 2.0μ correlates the mass gain of plugged filters. The equipment used in the experiments included: a pressurized combustor, an airflow facility (23m duct length), and a specially designed gravimetric balance for determining HEPA filter weight gain.

26743 (LA—9911-C-Vol.2, pp 419-433) **Principles of fire and explosion protection.** Thorne, P.F. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Selected principles of fire and explosion protection are described with reference to the avoidance of combustible media, and effective sources of ignition. The essential principles of fire detection systems are also given together with a discussion of reliability.

26744 (LA—9911-C-Vol.2, pp 479-493) **Quantifying the spread potentials of fires.** Harmathy, T.Z.; Mehaffey, J.R. Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Compartment fires can spread either by destruction or by convection. The potentials of spread by destruction and convection are quantified by the normalized heat load and by the μ-factor, respectively. These spread potentials are amenable to calculations, even though two of the input variables, fire load and ventilation, are random variables. The use of the normalized heat load in securing structural fire safety is described.

26745 (LA—9911-C-Vol.2, pp 495-513) **Calculations of wall fire spread in an enclosure.** Steckler, K.D. (National Bureau of Standards, Washington, DC). Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Mathematical models of fire growth in enclosures offer a potential for assessing the risk of materials with respect to a hazard such as flashover. A mathematical zone model for calculating fire spread over wall lining materials within an enclosure is presented. The local wall flame spread rate and burning rate per unit area are expressed in the model as functions of the external radiation incident upon the burning surface and the oxygen concentration in the adjacent gas layer (zone). Flame spread is limited to the horizontal direction. Results for a fictitious wall lining material are presented. Major elements of the results are shown to be in qualitative agreement with experience.

26746 (LA—9911-C-Vol.2, pp 545-558) **Precalculation of the effect of fires on mine ventilation systems.** Greuer, R.E. (Michigan Technological Univ., Houghton). Oct 1983. NTIS, PC A12/MF A01. (CSNI—83-Vol.2; CONF-830442—Vol.2).

From CSNI specialist meeting on interaction of fire and explosion with ventilation systems in nuclear facilities; Los Alamos, NM, USA (25 Apr 1983).

Mine fires interact with mine ventilation systems. It is described how mining engineers presently try to precalculate this interaction for the design of realistic fire emergency plans.

26747 (LBL—13500, pp 4.101-4.103) **Tests and criteria for fire protection of cable penetrations.** Williamson, R.B.; Fisher, F.L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division annual report, FY 1981.

An experimental concept to evaluate penetrations through walls or floor/ceiling assemblies in a true post-flashover compartment fire exposure is described. The concept is suited to test cable penetrations, accounting for pressure differentials maintained in nuclear plants to prevent the escape of radioactive materials. Another accomplishment reported is the further development of the probabilistic network approach to modeling fire spread. (LEW)

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 25880, 26667

26748 (DOE/ER/10865—T1) Theory for cross-coupling in ultrasonic transducer arrays. Baer, R.L.; Kino, G.S. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Mar 1984. Contract AT03-81ER10865. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010327.

Ultrasonic transducer arrays suffer from the effects of acoustic cross-coupling. The beam pattern and temporal response are degraded. The mechanism for acoustic cross-coupling has been postulated to be surface wave propagation along the array. Our theory has shown that surface waves are indeed responsible, and that they may propagate in either the backing or load medium. The new theory is based on an extension to periodic systems of the theory for excitation of a uniform semi-infinite substrate by a single line source. It provides a quantitative model for cross-coupling, as well as physical insight into its mechanism.

26749 (DOE/ET/29365—7) Development of a functional representation of the static VAR unit. (Purdue Univ., Lafayette, IN (USA)). Feb 1983. Contract AC01-79ET29365. 80p. NTIS, PC A05; 3; GPO Dep. Order Number DE84010588.

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It has been shown in past publications that static VAR systems entail several different applications. Accurate modelling of static VAR systems are lacking in today's literature. In this research, a functional representation of the static VAR unit is developed. The model is validated by comparing the functional representation to a detailed analog simulation. Further confidence in the model is obtained by applying it in a linearized form to examine the damping of subsynchronous oscillations in power systems. It is shown that it is necessary to model the dynamic time delay inherent in the static VAR unit (SVU) to accurately describe the SVU response to low frequency control signals. A higher order model of the unit is required if higher control frequencies are to be considered.

26750 (LA—10059-PR) Electronics Division research and development. Progress report, October 1, 1982-September 30, 1983. MacRoberts, M.D.J.; Courtney, E.J. (comps.). (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84011024.

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This report describes the status of the research development activities in the Electronics Division at the Los Alamos National Laboratory. Much of the work described is sponsored by the Laboratory; however, other topics are included for completeness. The Fuels Cells for Transportation Applications and the majority of the electrochemistry research are reported separately in LA-9787-PR. The Thermionic Integrated Circuits are being reported separately. The following topics are continuations of articles reported in Electronics Division Research and Development, October 1, 1981-September 30, 1982 (LA-9726-PR): Photoconductive Circuit Elements, Photoconductive Materials for Far-Infrared Detector Applications, Saturable Ferromagnetic Elements, Repetitive Opening Switches, Capacitor Test Facility, Fast Gating of Microchannel-Plate Image Intensifiers, and Oxygen-Reduction Reaction - Electrode Kinetics and Electrocatalysis. The following topics are new work or have been included for completeness: Photoconductive Power Switches, Ion Beam Analysis, Link Access Control and Encryption System, Coded Aperture Imaging of Gamma-Ray Sources, and Multilayer Printed Wiring Boards.

26751 (SAND—83-2254C) Lightning simulator circuit parameters and performance for severe-threat, high-action-integral testing. White, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 14p. (CONF-8406100—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009065.

From International conference on lightning and static electricity; Orlando, FL, USA (22 Jun 1984).

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The lightning simulator at Sandia National Laboratories (SNL) has been used to subject a number of DOE and military test items to severe levels of simulated lightning. This paper discusses some example circuits and circuit parameters related to tests made with this crowbarred Marx-generator-type simulator. Examples of fast-rising, high-peak, long-duration simulated lightning currents that have been produced into full-size test items are presented. Peak currents up to 250 kA with 1-μs rise times and action values up to greater than 6 x 10^6 A^2S have been injected into various test systems.

26752 (SAND—84-0406C) Transient response of GaAs microwave power FET to x-ray pulses. Armendariz, M.G.; Castle, J.G. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 9p. (CONF-840616—7). NTIS, PC A02/FM A01; 1; GPO Dep. Order Number DE84010145.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

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GaAs MESFETs, constructed with a 2-micron high-mobility low-conductivity VPE buffer layer, were exposed at room temperature to the x-ray pulse from a FEBETRON 705 source up to dose rates of 9 x 10^{10} rad(Si)/s. Upset of the 2-GHz output signal and its recovery time depended on how well the nominal 50-ohm test circuit lines were matched to 50 ohms. Strong increases in Ids tracked the x-ray pulse, approached peak values of two times IDSS and usually showed a ten percent tail which always disappeared in microseconds. Evidence for a backgating effect was not found. No primary photocurrents could be identified.

26753 (UCID—19925-Rev.1) Performance of Beverage antennas at low angles. Burke, G.J.; King, R.J.; Lytle, R.J.; Miller, E.K. (Lawrence Livermore National Lab., CA (USA)). Nov 1983. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011163.

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Numerical modeling of Beverage and monopole antennas shows the fields of both antennas to have a similar dependence on range and height above ground, with the Beverage antenna having slightly greater gain in the forward direction due to its directivity. The use of multiple Beverage antennas closely spaced was found to increase the efficiency and gain in the forward direction for short Beverage antennas. For the longer antenna considered for the HF bistatic radar, the decrease in directivity for two closely spaced antennas reduced the forward gain.

26754 Biasing and fast degaussing circuit for magnetic materials. Dress, W.B. Jr.; McNeilly, D.R. (to Dept of Energy). US Patent Application 6-539,011. 4 Oct 1983. 12p. Contract AC05-84OR21400.

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A dual-function circuit is provided which may be used to both magnetically bias and alternately, quickly degauss a magnetic device. The circuit may be magnetically coupled or directly connected electrically to a magnetic device, such as a magnetostrictive transducer, to magnetically bias the device by applying a dc current and alternately apply a selectively damped ac current to the device to degauss the device. The circuit is of particular value in many systems which use magnetostrictive transducers for ultrasonic transmission in different propagation modes over very short time periods.

26755 **Electron emitting filaments for electron discharge devices.** Leung, K.N.; Pincosy, P.A.; Ehlers, K.W. (to Dept. of Energy). US Patent Application 6-503,373. 10 Jun 1983. 18p. Contract AC03-76SF00098.

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Electrons are copiously emitted by a device comprising a loop-shaped filament made of lanthanum hexaboride. The filament is directly heated by an electrical current produced along the filament by a power supply connected to the terminal legs of the filament. To produce a filament, a diamond saw or the like is used to cut a slice from a bar made of lanthanum hexaboride. The diamond saw is then used to cut the slice into the shape of a loop which may be generally rectangular, U-shaped, hairpin-shaped, zigzag-shaped, or generally circular. The filaments provide high electron emission at a relatively low operating temperature, such as 1600°C. To achieve uniform heating, the filament is formed with a cross section which is tapered between the opposite ends of the filament to compensate for nonuniform current distribution along the filament due to the emission of electrons from the filament.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 25283, 26878

26756 **(CONF-840611—1) Behavior of coal ash and alkali matter in a coal-fired gas turbine system.** Ahluwalia, R.K.; Im, K.H.; Chuang, C.F.; Geyer, H.K.; O'Brien, T.J.; Berry, G.F.; Myles, K.M.; Petrick, M. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01. Order Number DE84003641.

From International gas turbine conference and exhibit; Amsterdam, Netherlands (4 Jun 1984).

The behavior of coal ash and corrosive alkali species in a gas turbine fueled by an ultra-clean coal water mixture (UCCWM) is investigated. A thermo-chemical equilibrium analysis is first conducted to study the effect of coal cleaning on the extent of vaporization of ash constituents. In order to study the fate of the vaporized constituents, a gas-to-particle conversion (condensation) model is formulated. The aerosol processes of homogeneous nucleation, heterogeneous nucleation, particle agglomeration, particle deposition, as well as direct vapor deposition on boundary surfaces are included in the formulation. The aerosol formation calculations are driven by the gas phase equilibrium chemistry of twelve elements and twenty seven gaseous species. The model is partially validated by comparison against available laboratory data on ash nucleation in a laminar flow furnace. Application of the model to UCCWM gas turbine system indicates that the deposition of sodium and potassium sulfates from the gas stream to the turbine blades is a two-step process: the alkali vapor first condenses on the submicrometer ash particles which in turn deposit on the turbine blades. A parameteric study has been carried out to establish the influence of coal cleaning and gas residence time in turbine on the fraction of alkali vapor condensed in the turbine.

26757 (LBL—13500, pp 4.66-4.70) **Combustion instabilities leading to flashback.** Vaneveld, L.; Hom, K.; Oppenheim, A.K. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Effects of buoyancy and of contraction at a combustor exit are examined as they relate to flashback, as well as the transition to flashback. (LEW)

26758 (LBL—13500, pp 4.70-4.73) **Ignition studies.** Oppenheim, A.K.; Hurlbut, F.C.; Robben, F.; Peterson, R.B.; Coico, P.A.; Stewart, H.E. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Contributions are reported in the areas of: rationalization of the technological significance of enhanced ignition and the methodology of controlled combustion; study of the fluid-mechanical properties of turbulent jets; anlaysis of the exothermic effects of combustion processes; and development of molecular-beam mass spectrometry, the direct measuring technique for the determination of the time-resolved evolution and decay of active radjcals in the course of ignition. (LEW0

26759 (LBL—13500, pp 4.77-4.80) **Combustion in a turbulent boundary layer.** Ng, T.T.; Cheng, R.K.; Robben, F.; Talbot, L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Premixed turbulent combustion in the heated turbulent boundary layer is studied. Studies were made in a wind tunnel, and laser Rayleigh scattering and single component laser Doppler velocimetry systems were used to measure statistics of density and two velocity components. General features of the heated turbulent boundary layer were studied, as was the reacting boundary layer. (LEW)

26760 (LBL—13500, pp 4.80-4.82) **Velocity statistics in premixed turbulent flames.** Cheng, R.K.; Ng, T.T.; Robben, F.; Talbot, L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The objective of the present program is the measurement of velocity statistics in a premixed turbulent flame of simple configuration using laser Doppler velocimetry (LDV). The flame configuration is a V-shaped ethylene/air sheet flame stabilized in turbulent flow with grid- or perforated-plate-induced turbulence. Also obtained are schlieren records showing the shape of the instantaneous flame sheet to facilitate the interpretation of the turbulence statistics in the flame.

26761 (LBL—13500, pp 4.84-4.86) **Staged fluidized bed combustor for the study of pollutant formation and destruction.** Sawyer, R.F.; LaFond, J.F.; Hart, J.R. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Staged combustion is an abatement technique that appears capable of reducing nitric oxide formation while also minimizing emissions of other pollutants. A two-stage fluidized-bed combustor, consisting of a fuel-rich fluidized bed followed by a fuel-lean fluidized bed, has been constructed. The fluidized beds provide additional control over temperature and residence time in comparison with conventional combustors. (LEW)

26762 (LBL—13500, pp 4.86-4.87) **Spouted-bed combustion.** Sawyer, R.F.; Ohtake, K.; Hart, J.R. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

A two-dimensional spouted-bed laboratory combustor has been designed and constructed with the objective of studying the interaction among gas flow, particle flow, and combustion. The laboratory facility, designed for a maximum thermal power of 20 kW, has a quartz front wall, providing full optical access to praticle flows and combustion processes. Initial studies employed premixed propane and air and a fixed bed height, bed material, injector slot width, and combustor geometry.

26763 (LBL—13500, pp 4.93-4.98) **Numerical modeling of turbulent combustion.** Chorin, A.J.; Ghoniem, A.F.; Oppenheim, A.K. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division annual report, FY 1981.

Studies of numerical modeling of turbulent combustion were concerned with three topics: evaluation of the properties of turbulent flow fields behind a rearward-facing step; analysis of unconfined jets; and extension of the random walk method to numerical modeling of diffusional processes, in particular heat conduction.

26764 **Integral low-energy thermite igniter.** Gibson, A.; Haws, L.D.; Mohler, J.H. (to Dept. of Energy). US Patent Application 6-494,487. 13 May 1983. 16p. Contract AC04-76DP00053.

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In a thermite igniter/heat source comprising a container holding an internal igniter load, there is provided the improvement wherein the container consists essentially of consumable consolidated thermite having a low gas output upon combustion, whereby upon ignition, substantially all of the container and said load is consumed with low gas production.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 25270, 26070

26765 **(BMFT-FB-T—83-236) Information evaluation by CRT display in district control.** Daus, J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 36p. (In German). NTIS (US Sales Only), PC A03 MF/A01. Order Number DE84750937.

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The objective was to develop a display system with adaptable screen display of underground operations. Connection of the required sensors had to be possible via standard interfaces. Results: Was developed a screen display unit constituted of a monitoring unit, CRT processor, and a power supply/monitoring unit. The whole equipment may be used in explosive atmosphere. The mechanical design of an inclinometer and distance-meter as well as the development of a power interface were completed. Scope and Advantages: A district control is the control and monitoring center in the underground mining area. Ever increasing information volumes require novel ways of representation. Screen display in a numeric and graphic form offers far-reaching opportunities of improving operational monitoring and thus productivity.

26766 **(BMFT-FB-T—83-263) Application of high speed water jets in conjunction with a mechanical impact device.** Lichtenberg, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 94p. (In German). NTIS (US Sales Only), PC A05 MF/A01. Order Number DE84750940.

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The mechanical impact device of an impact heading machine has been combined with installations producing high speed water jets. The water jets and device work the same point of the rock. This combination of the two energy-transferring systems aimed at increasing the working efficiency in homogeneous rock. This new device was tried on a sample of sandstone. During the tests it was recognized that the device penetrated deeper and faster into the material when supported by the water jets (psub(w) = 1000 bar, Qsub(w) = 12 l/min). Also the device created cracks in the material which did not occur without the water jets. The tests showed that the structural members of the high-pressure water system connected to the mechanical device are subjected to high intermittent forces, so that operational safety could not be guaranteed.

26767 **(EUR—7775-DE) Climate-management at high rock-temperatures and large extraction quantities.** (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.)). 1982. 133p. (In German). Commission of the European Communities, Luxembourg.

The results of the research being done are part of the attempts made by mines, mining companies and -institutes and other joint organisations in mining in order to provide air conditioning for high-performance coal faces and mechanised roadways which are used in areas with high rock temperatures. The Research Institute for air-conditioning and ventilation in mines (FG=Forschungsstelle fuer Grubenbewetterung und Klimatechnik) developed new or improved programmes of mine climate forecastes and also determined data by measurements in mines and roadways which are indispensable for quantitative calculations with satisfactory precision. Improved measuring instruments were developed as far as possible and necessary within the period given for research, this applies especially to the determination of heat emission of electric equipment. Air coolers were also tested in order to obtain further information on how to improve these vital components of air cooling systems.

4230 Marine Engineering

26768 **Progress in the development and testing of OTEC riser cables.** Soden, J.E. (Simplex Wire and Cable Co., Portsmouth, NH); Eaton, R.; Walsh, J.P. pp 587-595 of Ocean 82 conference report: Industry, government, education...partners in progress. Washington, DC; Marine Technology Society (1982). (CONF-820926—). Contract AC05-79ET29180.

From Marine Technology Society and Geological Society of America conference on oceans; Washington, DC, USA (20 Sep 1982).

Development testing and analysis of ocean thermal energy conversion (OTEC) riser cables has been undertaken. Two full-size riser cables have been manufactured and tested, one using cross-linked polyethylene (XLPE) insulation, the other using self-contained, oil-filled (SCOF) paper insulation. These cables and their components have been subjected to testing simulating handling and installation prior to OTEC service, as well as electrical and mechanical loads predicted in service. Results to date indicate that the XLPE cable has significant potential for use as an OTEC riser cable. The XLPE cable has performed well in mechanical and electrical testing. Results for the SCOF cable are mixed. The SCOF cable tested collapses due to pressure at depths typical of OTEC service and slippage occurs within the insulation resulting in early electrical failure of SCOF samples during combined electrical and mechanical tests. The implications of these findings for cable development and for the selection of a preferred candidate OTEC riser cable are discussed. 4 references.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 26756

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 26789, 27380, 27506, 27548

26769 **(ANL-HEP-CP—84-09) Comparison of some SSC beam parameters for pp and p anti p.** Diebold, R. (Argonne National Lab., IL (USA)). 12 Mar 1984. Contract W-31-109-ENG-38. 10p. (CONF-840275—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010729.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

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Based on discussions at the Ann Arbor workshop and early work on the Reference Designs Study, we present typical parameters for a pp SSC and compare them with anti p anti p parameters similar to those presented at this workshop by T.L. collins. This comparison is summarized in the table.

26770 **(BNL—34185) Tracking and computing.** Niederer, J. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 3p. (CONF-831264—15). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010513.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

This note outlines several ways in which large scale simulation computing and programming support may be provided to the SSC design community. One aspect of the problem is getting supercomputer power without the high cost and long lead times of large scale institutional computing. Another aspect is the blending of modern programming practices with more conventional accelerator design programs in ways that do not also swamp designers with the details of complicated computer technology.

26771 **(BNL—34614) High energy high intensity coherent photon beam for the SSC.** Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-840154—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010799.

From PSSC fixed target workshop; Woodland, TX, USA (27 Jan 1984).

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What is proposed for the 20 TeV protons hitting a fixed target is to make a tertiary electron beam similar to that which is the basis of the tagged photon beam at Fermilab. Briefly, a zero degree neutral beam is formed by sweeping out the primary proton beam and any secondary charged particles. Then the photons, from the decay of π^0 in the neutral beam, are converted to e^+e^- pairs in a lead converter and a high quality electron beam is formed. This beam is brought to the target area where it is converted to a photon beam by Bremsstrahlung in a radiator.

26772 **(DL/NUC/TM—62A) Intershield to tank sparks at the Daresbury tandem.** James, A.N. (Daresbury Lab. (UK)). Apr 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700943.

The causes of serious metallic melting and denting due to discharges in the insulating gas of the Daresbury tandem are examined. In order to explain the melting, high oscillating currents have to flow in the spark channels, and those can only be expected when return strokes excite local electromagnetic modes at the site of the origin of breakdown. In the case of intershield to tank sparks, evidence that magnetic confinement of the spark channel produces denting is presented. A model which accounts for the differences between sparks at Oak Ridge and sparks at Daresbury is also presented.

26773 **(LA-UR—84-1308) Practical aspects of tuning a ringed RFQ.** Purser, F.O.; Potter, J.M.; Humphry, F.J. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011366.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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A radio-frequency quadrupole (RFQ) constructed at Los Alamos for high-current H^- operation at 425 MHz and 2.0-MeV output energy has been retrofitted with vane coupling rings (VCRS) introduced at Berkeley. The initial set of seven complete VCR pairs produced excessive operating frequency change, and an arrangement of alternating horizontal and vertical coupling rings eventually was adopted. Because of the periodicity and length of the system, end effects were pronounced. A new type of end tuner was used to adjust the field strength at the ends of the structure that should be of general utility for high-power RFQs. Tuning data for various ring and tuning configurations are given. Operating data are given in a companion paper. 2 references, 7 figures, 1 table.

26774 **(LBL—17255) Review of induction linac studies.** Keefe, D. (Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 17p. (CONF-840142—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008497.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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The three major experimental activities are as follows: (1) The Single-Beam Transport Experiment (SBTE): A quadrupole transport system consisting of 5 matching lenses and 41 identical F-D lens pairs to test the stability, or otherwise, of transport of a high-current Cs^{+1} beam over a long distance; (2) The Multiple-Beam Experiment (MBE): An arrangement of long-pulse induction accelerating units between which are placed multiple-beam focussing arrays to transport 16 independent beams threading the same accelerating structure. The experiment is designed to simulate on a small scale as many as possible of the features to be encountered in the HTE; and (3) The High Temperature Experiment (HTE).

26775 (RL—83-010, pp 112-122) **Damage introduced into silicon by diamond turning.** Tanner, B.K.; Abdul Gani, S.M. (Durham Univ. (UK). Dept. of Physics); Bowen, D.K. (Warwick Univ., Coventry (UK). Dept. of Engineering). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

Silicon X-ray optical elements are in widespread use in crystallography, especially at synchrotron radiation sources where most experiments require a beam conditioner. As more demands are made on beam conditioners, manual methods of fabrication become impossible and use of diamond machining offers a versatile method of obtaining intricately figured components. In order to assess the suitability of the technique for the production of X-ray optical elements, a series of high perfection silicon specimens has been diamond turned under varying conditions. Surface flatness has been assessed visually and using a Talysurf 5 machine. The lattice perfection has been monitored by X-ray double crystal diffractometry, and the variation of damage with depth determined from the rocking curve width and integrated diffracted intensity as the surface layers were removed by controlled etching.

26776 **(RL—83-049) New ideas for accelerating particles.** Lawson, J.D. (Rutherford Appleton Lab., Chilton (UK)). 1983. 19p. (CONF-8304105—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700947.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

To be published in Nuclear Instruments and Methods.

Many different schemes can be devised for accelerating particles. In recent years several concepts radically different from those in common use have been suggested. Many of these have failed to live up to the hopes of their inventors. Now that we seem near the end of the road for large conventional machines, there is a renewed interest in alternatives, especially those involving lasers. Afte After a brief historical introduction and a discussion on how to classify different types of accelerator, some of these alternative concepts will be reviewed.

26777 **(SLAC-TN—84-3) Cable fabrication procedures for the BPM System.** Smith, W.B. (Stanford Linear Accelerator Center, CA (USA)). Jan 1984. Contract AC03-76SF00515. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011176.

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The Beam Position Monitor (BPM) System is a critical component of beam steering and control. It consists of the Beam Position Monitors (in the beamline), electronic signal processors (located remotely) and the cables that interconnect the two. Each BPM produces four signals. These four signals are then compared electronically with each other. Differences in amplitude among these signals is converted into information about the position of the beam as it passed that particular BPM. In order to provide the needed accuracy for this system, all four signals from each BPM must arrive at the processing electronics simultaneously. This means the interconnecting cables must be matched very precisely. The procedures described, when followed precisely, will assure the matching of BPM cables.

26778 **The Fermilab Tevatron.** Teng, L.C. (Fermi National Accelerator Laboratory, Batavia, IL 60510). pp 43-62 of Gauge theories, massive neutrinos, and proton decay. Kursunoglu, B.; Perlmutter, A. New York, NY; Plenum Publishing Corp. (1981). (CONF-810134—).

From Orbis scientiae conference; Fort Lauderdale, FL, USA (19 Jan 1981).

This chapter discusses the Fermilab Tevatron Project, which consists of the following 3 phases: Phase 0 (Saver)superconducting magnet ring, minimal refrigeration and rf; Phase I (TEV 1)- colliding beams, additional refrigeration and rf; and Phase II (TEV 2)-beam extraction and switchyard modifications; experimental areas and beam modifications and additions. Gives a description and status report of the Tevatron Project by priority groups designed to: 1) resolve all technological problems of a superconducting magnet synchrotron and demonstrate capability by accelerating a

beam; 2) provide capability and facility for doing fixed target physics; and 3) provide capability and facility for doing colliding beam physics. The goal of the project is to provide the first superconducting magnet synchrotron, the first 1 TeV beam, and the first 2 TeV colliding beams.

26779 **Polarized protons at the AGS.** Krisch, A.D. (Randall Laboratory of Physics, Univ. of Michigan, Ann Arbor, MI 48109). pp 11-41 of Gauge theories, massive neutrinos, and proton decay. Kursunoglu, B.; Perlmutter, A. New York, NY; Plenum Publishing Corp. (1981). (CONF-810134—).

From Orbis scientiae conference; Fort Lauderdale, FL, USA (19 Jan 1981).

This chapter discusses the project of modifying the Brookhaven AGS to allow the acceleration of polarized protons. Covers in some detail the accelerator physics and hardware involved in the project, and then briefly discusses some of the high energy physics results which make this project so exciting. Reviews the schedule and budget of the AGS project. Points out that there are 3 major problems in modifying the AGS to allow the acceleration of polarized protons: 1) a polarized ion source; 2) polarimeters to measure the beam polarization at various energies; and 3) jumping the various depolarizing resonances.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 26770

26780 **(BNL—34625) Working group summary: new technologies.** Luccio, A. (Brookhaven National Lab., Upton, NY (USA)). 19 Sep 1983. Contract AC02-76CH00016. 36p. (CONF-8309118—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010895.

From Topical meeting on free electron generation of extreme ultraviolet coherent radiation; Upton, NY, USA (19 Sep 1983).

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The discussion of undulator magnets includes conventional static undulators, gratings as undulators, crystals as undulators, pump wave undulators, magnetic measurements, magnetic fields, trajectories, and matching of an undulator with a storage ring. (GHT)

26781 (JINR-D—9-82-664, pp 161-163) **Study on intense relativistic electron beam propagation in a low density collisionless plasma.** Korenev, S.A.; Rubin, N.B.; Khodataev, K.V. 1982. (In Russian). NTIS (US Sales Only), PC A10/MF A01. (CONF-8205251—).

From Conference on collective methods acceleration problems; Dubna, USSR (18 May 1982).

The results of investigations into the increase in effectivity of transport of an intensive relativistic electron beam (IREB) in a collisionless plasma of low density are presented. The electron beam with the current of 1.5 kA, energy of 300 keV, radius of 1.5 cm is in ected into a plasma channel 180 cm long which is a metallic cylinder covered with a biniplast layer from inside 0.5 cm thickness on which there is a metallic net from the vacuum side. Plasma production is carried out during the supply of voltage pulse to the net. A condition of the optimum IREB distribution is found. It is sohwn that self-focusing IREB transport in plasma of low density can be effective if equilibrium conditions are carried out in plasma with the concentration of electrons less (or equal) to the concentration of electrons in a beam.

26782 **(LA-UR—84-1191) Electron beam diagnostic for the Los Alamos free-electron laser oscillator experiment.** Sheffield, R.L. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011348.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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An electron beam diagnostic for the Los Alamos free-electron laser (FEL) oscillator experiment has been used to measure the time dependence of the electron energy distribution in a 100-μs time interval. The electron beam consists of macropulses that have a duration of 100 μs and a repetition rate of 1 Hz. Each macropulse consists of a series of micropulses that have $\sim$ 30 ps duration, $\sim$ 50 A peak current, and $\sim$ 50 ns separation. The primary purpose of the electron beam diagnostic is measurement of the time dependence of the electron energy distribution during the build-up of the photon field in the oscillator. Since the exact time of build-up depends on various rf and cavity considerations, provisions were made to allow the observation window to be varied from 10 to 100 μs and to be delayed by times up to 100 μs. 5 references, 9 figures.

26783 **(LA-UR—84-1217) Free-electron lasers and related topics.** Watson, J.M. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840529—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011332.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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This past year has been very exciting for the experimental free-electron laser (FEL) programs. At three Laboratories, oscillator experiments were performed with wavelengths from the visible to far infrared. The output powers are steadily advancing. The status of these programs will be discussed. As shorter wavelengths and higher powers are pursued, higher currents with improved beam quality will be required. Advanced electron linacs should be developed to meet these demands. 13 references, 5 figures, 3 tables.

26784 **(LA-UR—84-1279) General-purpose RFQ design program.** Wadlinger, E.A. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 3p. (CONF-840529—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011327.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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We have written a general-purpose, radio-frequency quadrupole (RFQ) design program that allows maximum flexibility in picking design algorithms. This program optimizes the RFQ on any combination of design parameters while simultaneously satisfying mutually compatible, physically required constraint equations. It can be very useful for deriving various scaling laws for RFQs. This program has a friendly user interface in addition to checking the consistency of the user-defined requirements and is written to minimize the effort needed to incorporate additional constraint equations. We describe the program and present some examples.

26785 **(LA-UR—84-1280) Designing self-matching linacs.** Mills, R.S.; Crandall, K.R.; Farrell, J.A. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011326.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The present trend in ion-linac design is to begin with a radio-frequency quadrupole (RFQ) linac followed by one or more drift-tube linac (DTL) tanks in which permanent-magnet quadrupoles are used for transverse focusing. The lack of adjustable elements (knobs) strongly suggests that one should seek linac designs with intertank matching solutions that are insensitive to beam currents and emittances, which can be accomplished if there are no sharp discontinuities in the focusing properties along the entire linac. Guidelines are presented for linac design and describe techniques for longitudinal as well as transverse matching between tanks. For a wide range of beam currents and emittances, a beam matched at the entrance to the RFQ should remain well matched throughout the entire linac.

26786 **(LA-UR—84-1282) TRACE: an interactive beam-transport code.** Crandall, K.R.; Rusthoi, D.P. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—21). NTIS, PC A02; 3; GPO Dep. Order Number DE84011407.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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TRACE is an interactive, first-order, envelope-tracing, beam-dynamics computer code with space charge. It includes some unique features as well as a number of elements not commonly found in other beam-transport programs such as the permanent-magnet quadrupole (PMQ), radio-frequency quadrupole (RFQ), rf gap, accelerator column, and accelerator tank. The code also has a number of fitting capabilities, allowing almost any element parameter in the beamline to be varied, including space charge. TRACE calculations provide immediate graphic display, including the beam envelope and the phase-space ellipses in the transverse dimensions. The program is easy to use and contains its own help package that lists all instructions necessary for input, calculations, and graphic output.

26787 **(LA-UR—84-1342) Lumped-circuit model of four-vane RFQ resonator.** Wangler, T.P. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011343.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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Although the rf cavity code SUPERFISH is a necessary tool for designing rf cavities, it is often useful to have approximate analytic formulas for the electromagnetic properties of a cavity. One approach for the RFQ four-vane cavity is to use the analtytic solutions associated with an inclined plane waveguide. The large capacitive vane loading in the four-vane RFQ resonator allows a convenient representation by a simple lumped-circuit model. Formulas are derived that depend on a single unknown parameter: the vane capacitance per unit length, which can be calculated for different vane geometries using SUPERFISH. The formulas from the model are useful for estimating the RFQ's electromagnetic properties as a function of parameters such as frequency and intervane voltage.

26788 **(LA-UR—84-1349) Exploration of phase stability in the surfatron accelerator.** Neuffer, D.V. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011416.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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Proton and electron motion in a laser beat-wave accelerator with a transverse magnetic field is explored. Parameters of stable acceleration are determined analytically and by simulation. The effects of synchrotron radiation on electron acceleration are also explored.

26789 **(LBL—17283) 6.5 Tesla SSC lattice example.** Garren, A.A. (Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 7p. (CONF-831264—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010719.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

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This note presents an example SSC collider lattice for 20 TeV proton beams using 6.5 Tesla double bore magnets, six collision points, and anti-symmetric insertions.

26790 **(LBL—17561) Beam experiment programs in the USA.** Kim, C. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 6p. (CONF-840142—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010804.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

It has been demonstrated that an intense beam with the space charge defocussing force as large as the average focussing forces of the channel can be transported over many lattice periods without losing either the current or the optical quality. This conclusion, which is consistent with the PIC code results, has an important implication in designing a linear induction accelerator driver for inertial confinement fusion.

26791 **(SLAC-PEP-NOTE—380) Analysis of damping measurements in PEP.** Bishop, K. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 36p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010726.

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This report deals with the mathematical analysis of damping measurements performed at PEP. The experiment involved beam position measurements as a function of time following an initial excitation or displacement. The motion was predictably described as a linear combination of exponentially damped sinusoids representing the motion in both the horizontal and vertical directions. A variety of mathematical techniques were applied in order to determine the damping coefficients themselves, and their relationship to beam and accelerator parameters such as current and chromaticity. The most reliable of these methods involved an application of the convolution theorem for Fourier transforms in order to filter out unwanted oscillations by their characteristic frequencies. This method, when applied to the experimental data, yielded damping coefficients that were consistent with the Head Tail Instability model. 25 figures.

26792 **(SLAC-PUB—3305) Measuring emittances and sigma matrices.** Rees, J.; Rivkin, L. (Stanford Linear Accelerator Center, CA (USA)). Mar 1984. Contract AC03-76SF00515. 4p. (SLAC/AP—18). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008846.

The method used for measuring emittance at the SLAC Linac and the linear collider damping ring is described. The basis of the method is derived using one two-by-two matrix to specify the state of the input beam (σ matrix) and another to describe the lens-drift transport system (R-matrix). (GHT)

26793 **(UCRL—88924) Observed current enhancement with propagation of the ETA electron beam in air.** Clark, J.C.; Struve, K.W.; Yu, S.S.; Melendez, R.E. (Lawrence Livermore National Lab., CA (USA)). 03 Apr 1984. Contract W-7405-ENG-48. 16p. (CONF-830911—39). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010558.

From 5. international conference on high power particle beams; San Francisco, CA, USA (12 Sep 1983).

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It is observed with the ETA electron beam propagating in air that the net current exceeds the beam current for pressures between 20 and 500 Torr. Microwave measurements indicate that this current enhancement is distinctly different than that associated with the two-stream instability at low pressure. Detailed measurements of its dependence on pressure, current, beam size, and propagation distance are given. A theory is proposed that attributes the additional forward current to energetic secondary electrons pushed forward by the beam self-magnetic field. Detailed comparison of measurements with the results of a non-local Boltzmann code are made.

26794 **(UCRL—90243) Longitudinal bunching of electrons in the Advanced Test Accelerator.** Neil, V.K.; Caporaso, G.J.; Paul, A.C. (Lawrence Livermore National Lab., CA (USA)). 6 Apr 1984. Contract W-7405-ENG-48. 5p. (CONF-840529—4). NTIS, PC A02; 3; GPO Dep. Order Number DE84010553.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The Advanced Test Accelerator (ATA) is a linear induction accelerator for electrons with design goals of 50 MeV and 10 kA. The accelerator consists of a 2.5 to 3 MeV injector and 170 accelerating units, each unit capable of an applied voltage up to 350 kV. At a number of positions in the accelerator, the return current in the beam pipe is measured as a function of time as the beam passes that position. The measuring device, a four quadrant addition, is somewhat sensitive to the transverse position of the beam centroid as well as transverse distribution of current in the beam. Therefore

a time-dependent signal may indicate time-dependent transverse motion or beam structure as well as an axial modulation of the beam current. These signals sometimes exhibit spikes and notches on the leading and trailing edges of the beam pulse. The presence of these rapidly varying signals during the rise and fall of the current stimulated this work. 2 references, 4 figures.

26795 **Stability of the Kapchinskij-Vladimirskij (K-V) distribution in long periodic transport systems.** Hofmann, I.; Laslett, L.J.; Smith, L.; Haber, I. (Lawrence Berkeley Lab., CA (USA)). *Particle Accelerators;* **13**: No. 3-4, 145-178(Sep 1983).

Transport of intense beams of heavy ions over long distances may be restricted by space-charge induced transverse instabilities. The stability of the microcanonical, or K-V, distribution is analyzed with the help of the Vlasov equation, and reduced to a study of the characteristics of solutions for a set of ordinary differential equations with periodic coefficients. Numerical solutions for various periodic solenoid and quadrupole focusing channels are derived and provide information concerning stable regions of propagation in terms of betatron tune depression. The results are compared with computer simulation examples of beams in solenoid and quadrupole focusing channels to check linear growth rates and establish nonlinear saturation levels of instabilities. Conclusions are drawn for the design of a quadrupole lattice providing stable transport.

26796 **Electrostatic wire stabilizing a charged particle beam.** Prono, D.S.; Caporaso, G.J.; Briggs, R.J. (to Dept. of Energy). US Patent Application 6-477,458. 21 Mar 1983. 23p. Contract W-7405-ENG-48.

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In combination with a charged particle beam generator and accelerator, apparatus and method are provided for stabilizing a beam of electrically charged particles. A guiding means, disposed within the particle beam, has an electric charge induced upon it by the charged particle beam. Because the sign of the electric charge on the guiding means and the sign of the particle beam are opposite, the particles are attracted toward and cluster around the guiding means to thereby stabilize the particle beam as it travels.

26797 **Lectures in accelerator theory.** Month, M. (Brookhaven National Laboratory, Upton, NY 11973). pp 405-458 of Techniques and concepts of high-energy physics. Ferbel, T. New York, NY; Plenum Publishing Corp. (1981). (CONF-8007121—).

From NATO advanced study institute on techniques and concepts of high-energy physics; St. Croix, VI, USA (2 Jul 1980).

Three phenomena of accelerator theory, which studies the behaviour of particle beams--the theory of single particle motion in nonlinear field, the theory of high intensity coherent motion, and the theory of coherent accumulation--are described. First, the behaviour of particles in a nonlinear field arising from the electromagnetic interaction of colliding beams, where counterrotating proton beams cross each other at a non-zero angle is studied. Beam-beam geometry, beam-beam interaction for ISABELLE, and the resonance theory of beam-beam interaction in ISABELLE are included. Second, the development of travelling waves on particle beams is studied in a situation where a uniform beam current in a circular accelerator and the excitation for the coherent motion is induced by the resistivity of the vacuum chamber wall. Electromagnetic fields are reviewed, the dispersion relation is specified, and an example of coherent stability for a point beam is given. Finally, the current accumulation process used at the proton storage rings at CERN (the ISR) is given, with focus on the incompressible fluid model (IFM).

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 26669, 26755, 26780, 27242, 27296

26798 **(BNL—34518) AGS experiments - 1982, 1983, 1984.** Bunce, G. (Brookhaven National Lab., Upton, NY (USA)). 22 Dec 1983. Contract AC02-76CH00016. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010788.

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The report contains layouts of experimental areas, a table of beam parameters and fluxes, the experiment schedule as run, the experiment long range schedule, a listing of experiments by number, and a section of two-page summaries of each experiment. (GHT)

26799 **(BNL—34525) D phi detector.** Aronson, S.H. (Brookhaven National Lab., Upton, NY (USA)). 15 Mar 1984. Contract AC02-76CH00016. 8p. (CONF-840396—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84010291.

From International conference on instrumentation for colliding beam physics; Novosibirsk, USSR (15 Mar 1984).

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The D phi experiment is a recently approved effort at FERMILAB to study proton-antiproton collisions at 2 TeV. A powerful new detector has been designed for this experiment and is described. The D phi detector has been designed to optimize its discovery potential in the mass range where deviations from the Standard Model might be expected to manifest themselves. Rather than discussing the detector's response to particular hypothetical new states (Higgses, squarks, etc.), we focus here on more technical capabilities (leptons, jets, etc.). After a brief physics summary to motivate our technical choices, we consider the detector design subsystem by subsystem. 9 references.

26800 **(CONF-831180—) Production and neutralization of negative ions and beams. AIP Conference Proceedings No. 111 .** Prelec, K. (ed.). (American Inst. of Physics, New York). 1984. Contract AC02-76CH00016. 802p. American Institute of Physics, 355 East 45th St., New York, NY 10017.

From 3. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (14 Nov 1983).

This meeting was the third in the series of symposia on the production and neutralization of negative ions and beams, organized by Brookhaven National Laboratory. The objective of the symposium was to review the progress in the knowledge and understanding of fundamental processes related to the production of negative and neutral particles and beams, to review the state of the development of devices and systems, and to try to establish guidelines for future needs and work. This time there were some changes introduced compared to the two previous symposia: heavier negative ions as well as polarized negative hydrogen ions were included in the program, both because of a recently expressed interest for fusion and other applications.

26801 **(EUR—7985) Use of a visible light spectrophotometer for nuclear target production control.** Wesenbeek, J.; Pauwels, M.; Pauwels, J.; Gestel, J. van. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1982. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700948.

As nuclear target preparation laboratories have a permanent need for production control techniques which are fast, easy and nondestructive, the use of visible light spectrophotometry was investigated for thickness measurements of thin plastic substrate foils and evaporated fluoride layers. Thin plastic foils were measured using different methods, using both transmission and reflection modes. Under optimal conditions thicknesses between 20 and 80 $\mu g/cm^2$ may be measured with precisions of the order of 0.5 $\mu g/cm^2$ (1s). The accuracy of the measurements is 2% for polyimide, vyns, formvar and polysulphone, and 5% for parylene. Slightly less precise results were obtained using a simplified calibration method. Particularly interesting is that the method can also be used on foils coated on glass plates. Evaporated Li, Th, U and Pu fluoride layers on stainless steel backings were measured in the reflection model. For thicknesses between 20 and 500 $\mu g/cm^2$ accuracies between 2 $\mu g/^2$ and 10 $\mu g/cm^2$ were obtained. The methods is non-destructuve and very fast (2 to 3 minutes per measurement).

26802 (IFVE-FTOPK—82-132) Calculation of superconducting sectionized solenoids. Kostrikov, M.E.; Kostrikova, D.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1982. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700944.

Portions are illegible in microfiche products1 refs.; 2 figs.

The method for calculation of a sectionized solenoid with any number of coaxial sections for an arbitrary form of critical current density dependence on a magnetic field is proposed. The method is based on approximation of isub(c)(B) dependence by several linear sections and permits for a specified magnetic field value in the solenoid center to calculate such current densities in sections and their dimensions which provide the minimum external radius.

26803 (LA—9931) Extraction of H^- beams from a magnetically filtered, multicusp source. York, R.L.; Stevens, R.R. Jr.; Leung, K.N.; Ehlers, K.W. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011013.

H^- ions produced by volume processes were extracted from a multicusp source operated with a magnetic filter and accelerated to form a high-quality beam. The H^- beam current increased almost linearly with the discharge current. An H^- ion current density of 38 mA/cm^2 was obtained with a discharge current of approximately 350 A. The accelerated beam was mass-analyzed, and the emittance of the H^- component was measured. The electron component and the percentage of ion impurity in the extracted beam were also determined.

26804 (LA—10063-MS) Radial particle distributions in PARMILA simulation beams. Boicourt, G.P. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011007.

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The estimation of beam spill in particle accelerators is becoming of greater importance as higher current designs are being funded. To the present, no numerical method for predicting beam-spill has been available. In this paper, we present an approach to the loss-estimation problem that uses probability distributions fitted to particle-simulation beams. The properties of the PARMILA code's radial particle distribution are discussed, and a broad class of probability distributions are examined to check their ability to fit it. The possibility that the PARMILA distribution is a mixture is discussed, and a fitting distribution consisting of a mixture of two generalized gamma distributions is found. An efficient algorithm to accomplish the fit is presented. Examples of the relative prediction of beam spill are given. 26 references, 18 figures, 1 table.

26805 (LA-UR—84-866) Focal plane polarimeter design. McClelland, J.B. (Los Alamos National Lab., NM (USA)). 12 Oct 1983. Contract W-7405-ENG-36. 9p. (CONF-8310234—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84010056.

From Magnetic spectrometer workshop; Williamsburg, VA, USA (9 Oct 1983).

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Measurement of polarization transfer or so-called triple-scattering parameters have been made recently for proton-nucleon scattering at TRIUMF, SIN, and LAMPF using carbon polarimeters and have been essential in determining the proton-nucleon amplitudes up to 800 MeV. An extension to the case is described where the scattered proton polarization is analyzed after passage through some type of spectrometer. Most of the experience with this type of focal plane polarimeter (FPP) has been gained in the field of proton-nucleus scattering at intermediate energies but is certainly not confined to such specific cases. The salient features of an FPP are emphasized by describing a minimal system which includes all the necessary components then go on to a more complete system. 10 references. (WHK)

26806 (LA-UR—84-1232) Status of the new high intensity H^- injector at LAMPF. Stevens, R.R. Jr.; York, R.L.; McConnell, J.R.; Kandarian, R. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011330.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The requirement for higher intensity H^- ion beams for the proton storage ring now being constructed at LAMPF necessitated the development of a new H^- ion source and the rebuilding of the original H^- injector and its associated beam transport lines. The goal of the ion source development program was to produce an H^- beam with a peak intensity of 20 mA at 10% duty factor and with a beam emittance of less than 0.08 cm-mrad normalized at 95% beam fraction. The ion source concept which was best suited to our requirements was the multicusp, surface-production source developed for neutral beam injectors at Berkeley by Ehlers and Leung. An accelerator version of this source has been subsequently developed at Los Alamos to meet these storage ring requirements. The use of these higher intensity H^- beams, together with the more stringent chopping and bunching requirements entailed in the operation of the storage ring, now requires rebuilding the entire H^- injector at LAMPF. This construction is in progress. It is anticipated that the new injector will be fully operational by the end of 1984 and that the required H^- beams will be available for the operation of the storage ring in early 1985.

26807 (LA-UR—84-1348) High power testing of the multiple-loop radio-frequency drive concept for the FMIT accelerator. Fazio, M.V.; Patton, R.D. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011417.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The Fusion Materials Irradiation Test (FMIT) accelerator requires several 600-kW rf systems to simultaneously supply rf power to a single accelerator tank. Each rf-system output must be carefully phase and amplitude controlled to achieve the proper system performance. Two 80-MHz, 600-kW rf amplifiers with phase- and amplitude-control systems have been tested into a single, high-Q resonant cavity. Experimental results are presented.

26808 (RL—82-086) Reconstruction of data in low-mass magnetostrictive chambers. Daley, H.M. (Rutherford Appleton Lab., Chilton (UK)). Jan 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700945.

The reconstruction of spark positions in a set of low-mass spark chambers with remote magnetostrictive readout, used in a study of the reaction $\pi^- p \rightarrow K^0 \Lambda$, is described. The main detectors used were optical spark chambers but in order to provide information close to the vertices low-mass magnetostrictive chambers were fitted inside the cone of the superconducting polarised target magnet.

26809 (SLAC-PUB—3328) Isolated grid electron gun and pulser system for long/short pulse operation. Koontz, R.F.; Feathers, L.; Kilbourne, C.; Leger, G.; McKinney, T. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 3p. (CONF-840529—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011197.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

The new NPI gun at SLAC serves the dual functions of producing long pulse (up to 5 μsec, 180 pps) electron bursts for nuclear physics experiments, and also short (1 nsec) pulses for filling Stanford Synchrotron Radiation Laboratory (SSRL). This is accomplished by means of a newly designed, isolated grid gun, cathode pulsed with a solid state long pulse pulser, and grid pulsed with a fast recharging avalanche type short pulse (1 nsec) grid pulser. The grid pulser is bipolar so that a fast blackout notch can be placed in the long cathode pulse. This fast notch can be seen by Stanford Linear Collider (SLC) instrumentation and allows the

long pulse beam to be computer controlled by SLC intensity and beam position monitors.

26810 **(SLAC-PUB—3329) New injector (NPI) for nuclear physics at SLAC.** Koontz, R.F. (Stanford Linear Accelerator Center, CA (USA)). May 1984. Contract AC03-76SF00515. 3p. (CONF-840529—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010966.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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A program of nuclear physics experiments has been approved at SLAC, and a new high average current injector is being added to the accelerator 650 meters upstream (Sector 25) of the accelerator output. The new injector (NPI) will produce beams in End Station A of up to 150 mA, 1.6 μsec, 180 pps at energies from 0.5 to 6 GeV. NPI will also have 1 nsec short pulse capability for electron injection into SSRL. Work on NPI started in October of 1983, and the first beam from the new injector is scheduled for the Fall of 1984.

26811 **Second-order path length terms for a general bending magnet.** Carey, D.C. (Fermi National Accelerator Lab., Batavia, IL (USA)); Servranckx, R.V. (Saskatchewan Univ., Saskatoon (Canada)). *Particle Accelerators;* **13**: No. 3-4, 199-207(Sep 1983).

Second-order terms are derived for the path length through a non-uniform-field bending magnet. The field is specified by its value on the reference trajectory, and its first and second derivatives with respect to the radial coordinate. This extends the catalogue of second-order path length terms derived previously. The results have been incorporated into the computer programs TRANSPORT, TURTLE, and DIMAT.

4304 Storage Rings

26812 **(LBL—17686) Coherent vuv and soft x-ray radiation from undulators in modern storage rings.** Kim, K.J.; Halbach, K.; Attwood, D. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 14p. (CONF-840387—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010715.

From 2. topical meeting on laser techniques in the extreme ultraviolet; Boulder, CO, USA (5 Mar 1984).

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Magnetic structures in modern storage rings provide an assured route to fundamentally new opportunities for extending coherent radiation experiments to the vacuum ultraviolet and soft x-ray spectral regions. Coherent power levels of order 10 milliwatts are anticipated, in a fully spatially coherent beam, with a longitudinal coherence length of order 1 μm. In addition to broad tuneability and polarization control, the radiation would occur in 20 psec pulses, at 500 MHz repetition rate.

26813 **Intrabeam scattering.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)); Mtingwa, S.K. (Fermi National Accelerator Lab., Batavia, IL (USA); Illinois Univ., Chicago (USA). Dept. of Physics). *Particle Accelerators;* **13**: No. 3-4, 115-143(Sep 1983).

The contribution to emittance growth rates due to Coulomb scattering of particles within relativistic beams such as those found in colliders and accumulator rings is calculated. The variation of lattice parameters around the ring is allowed for, which is the case for typical strong-focusing lattices presently being studied. It is found that the emittance growth corresponds to a tendency of the beam rest-frame momentum space to relax to a spherical shape. Finally, the results were applied to the Antiproton Accumulator and Energy Saver lattices currently being built at Fermilab.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 25579, 25991, 26799, 26805, 26808, 26913, 27040, 27041, 27042, 27043, 27131, 27132, 27134, 27135, 27136, 27137, 27139, 27140, 27141, 27142, 27144, 27148, 27399

26814 **(BNL—33860) Brookhaven FASTBUS ADC's.** Schmidt, M.P.; Black, J.K.; Blatt, S.R.; Campbell, M.C.; Kasha, H.; Schwarz, C.B.; Benenson, G.; Larsen, R.C.; Leipuner, L.B.; Morse, W.M. (Yale Univ., New Haven, CT (USA); Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 3p. (CONF-831015—47). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84002688.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

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A high energy physics experiment has been performed at Brookhaven National Laboratory on k/sub L/$^0 \rightarrow 2\pi^0$ decays employing a large (> 200 element) lead glass array as an electromagnetic calorimeter. To acquire pulse height information from the detector we have constructed ADC modules in the context of the Brookhaven Fastbus data acquisition system. Digitization (8 bits) and encoding, including pedestal subtraction and data sparsing, is achieved for each 16 channel module in 6 μsec.

26815 (JINR-D—2-82-568, pp 83-91) **Two-arm magnetic spectrometer for investigation in the field of relativistic nuclear physics (MASPIK-2 device).** Azhgirej, L.S.; Vzorov, I.K.; Zhmyrov, V.N. (and others). 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

A MASPIK-2 experimental device, a two-arm magnetic spectrometer with wire spark chambers on line with an electronic computer intended for the investigation into the nuclear reactions mechanism for relativistic energies in the JINR synchrophasotron extracted particle beams is described. A flowsheet of device electron apparatus is described as well; its basic parameters are given. Fundamental physical problems, which solutions are possible by means of this device, were considered. Spectra of secondary protons and deuterons emitted at an angle of 140 mrad during the interactions of deuterons and hydrogen, deuterium and carbon nuclei at an initial deuteron momentum of 9 GeV/c were measured.

26816 (JINR-D—2-82-568, pp 98-101) **100-cm hydrogen bubble chamber and investigating relativistic light nuclei-hydrogen interaction.** Glyagolev, V.V.; Lebedev, R.M. 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

Basic physical and technical characteristics of 100 cm hydrogen bubble chamber used for the investigation of the relativistic light nuclei interaction with hydrogen are given. 5 GeV/c momenta of charged particles at 50 cm length of the measured track were measured at 2% error and at 30 cm track length - 4%. The effective mass resoluction for two- and three-particle combinations of the charged particles constitutes 5-10 MeV. Investigations into the deuterium nucleus interactions with helium in tne process of which determined were topogical cross sections, yield of pions and nucleus fragments, peculiarities of some reactions. Possibilities in connection with the acceleration at a polarized deuteron synchrophasotron were noted.

26817 (JINR-D—2-82-568, pp 120-124) **Main parameters of the GIBS spectrometer.** Matyushin, V.T. 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

A hybrid type spectrometer based on a large streamer chamber and wire coordinate detectors (GIBS device) and intended for

investigations into the production of strange particles, antiparticles, cumulative processes during the interactions of neon and argon with heavy targets, proton-deuteron interactions at 10 GeV/c accompanying with the production of cumulative protons is described. Given are characteristics of main device units and parameters which are suggested to obtain in the process of its assimilating. Basic developments of the streamer chamber are directed at the improvement of track measurement accuracy, the increase of reliability and a device automatization level. The device is suggested to place in the JINR synchrophasotron extracted beam.

26818 (JINR-R—1,2,13-83-81, pp 7-18) **New neutrino detector for Serpukhov synchrotron.** Barabash, L.S.; Bunyatov, S.A.; Golutvin, I.A. (and others). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

A neutrino detector of calorimetric type designed on the basis of a calorimeter-target and a muon spectrometer consisting of cells with liquid scintillators and drift chambers is described and its performances are given. The detector is designed for operating with muon and electron neutrino beams in the 2-30 GeV energy range at the IHEP proton synchrotron. A program of physical experiments with neutrino beams after booster start-up is considered. The program includes a study of νsub(μ)sup((-))e- and νsub(μ)sup((-))p-elastic scattering on muon neutrino beams with wide spectrum, a study of inclusive reactions with neutral and charged currents in monochromatized beams and in the beam enriched with electron neutrinos. The new detector will also allow to get the information about neutrino scintillations and generation of charm particles in proton-nuclear interactions by detecting "direct neutrinos" from their decay.

26819 (JINR-R—1,2,13-83-81, pp 30-33) **Performance testing of drift chambers by means of pulse x radiation.** Bozhko, N.I.; Borisov, A.A.; Vovenko, A.S.; Kozhin, A.S.; Tumakov, V.L.; Fakhrutdinov, R.M.; Filippov, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Testig results for a big drift chamber tested by means of a pulse x-ray source are given. It is found that the efficiency plateau of x-ray detection (350-400 V) is greater than that for relativistic charged particles (150-200 V). Drift time distributions in a chamber filled with the Ar+6% CO_2 mixture are determined for two source positions and several values of electric field strength in a drift gap. Deviations from linearity for the deaendence of beam coordinate on drift time, as well as transverse dimensions of areas of electron collection on a signal wire and their dependence on x-ray source coordinates are given. It is shown that the pulse x-ray source permits to determine performances of a drift chamber with a big drift gap and find uniformity disturbances in the electric field distribution inside the chamber.

26820 (JINR-R—1,2,13-83-81, pp 34-36) **Fabrication of drift chambers for the IHEP neutrino calorimeter in 1981.** Borisov, A.A.; Vovenko, A.S.; Zavodchikov, N.V.; Kirichenko, G.P.; Kozhin, A.S.; Korobchuk, P.I.; Pyt'tsyn, V.N.; Tumakov, V.L.; Filippov, G.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

A technological procedure of drift chamber preparation for operation with a neutrino calorimeter is described. A set of control and measuring procedures is considered. Main attention is paid to the chamber internal volume cleanliness, electric strength of casing insulation and its tightness, and measuring the current and countering performances.

26821 (JINR-R—1,2,13-83-81, pp 37-42) **Investigation of drift chamber mock-up performances.** Barabash, L.S.; Golutvin, I.A.; Zamyatin, N.I. (and others). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

A multiwire drift chamber mock-up consisting of two panels and a box-like casing is described. Results of investigations of electrostatic forces of interaction between the wires are given. Performances of the drift chamber are measured on benches with radioactive sources and with a charged particle beam for five gas mixtures. The efficiency and accuracy of track detection in the chamber and the particle beam profile are determined. The possibility to use the given results in designing a full-scale prototype of a drift chamber for a neutrino detector is estimated.

26822 (JINR-R—1,2,13-83-81, pp 43-45) **Amplifier-shaper with low threshold for a big drift chamber.** Barabash, L.S.; Omel'yanenko, A.A.; Omel'yanenko, M.N. 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

An amplifier-shaper with low threshold for a big drift chamber capable to operate in a wide range of input signals is described. The amplifier is made on the base of four transistors and it has an increased pulse quality for optimum signal formation. The shaper is a univibrator made on the basis of a one-shot multivibrator circuit. Dependences of the efficiency and accuracy of track detection on the drift chamber supply voltage are given.

26823 (JINR-R—1,2,13-83-81, pp 64-69) **Electron shower counter performances for neutrino calorimeter.** Vovenko, A.S.; Kochetkov, V.I.; Kravtsov, V.I.; Mukhin, A.I.; Salomatin, Yu.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Calibration of a mock-up of a shower detector for a neutrino calorimeter with 1-5 GeV electron beam is considered. The studied electron detector mock-up is a set of scintillation plates between which lead converters are installed. Light is collected in the mock-up from faces of scintillation plates by two photomultipliers. The obtained data are transferred to a computer through analog-to-digital converters. The data on energy resolution of the shower electron detector mock-up, the efficiency of electron and hadron separation, number of photoelectrons produced by a minimally ionizing particle are given. It is shown that in the studied energy range the pulse distribution is a linear function of incident electron energy.

26824 (JINR-R—1,2,13-83-81, pp 70-77) **Pointing out and identification system in a vertex detector for secondary particles.** Bunyatov, S.A.; Volkov, A.D.; Zhukov, A.V.; Zalikhanov, B.Zh.; Komissarov, E.V.; Serdyuk, V.Z.; Shandor, M. (Joint Inst. for Nuclear Research, Dubna (USSR)); Kish, D. (3635420HU). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Systems for pointing-out and indentification of charm particle decay products in a vertex detector are considered. Electroluminescence drift chambers with great sensitive area are used as track detectors in the pointing-out system. Light collection of a luminescence signal is performed by a spectrum mixer made on the base of polysterene or polyvinylacrylate. The drift time is measured in several drift gaps through one photochannel. The numbers of triggered drift sections are determined by electric signals fro.m anode wires connected in coincidence with a photochannel. The drift time measurement accuracy is 1 to 0.2 ns. For particle identification the time-of-flight method and Cherenkov radiation light cone angle measurement are used. That is why besides the electroluminescence drift chambers a Cherenkov detector is used in the vacuum ultraviolet range.

26825 (JINR-R—1,2,13-83-81, pp 144-147) **Remark on the peculiarities of neutrino detector operation at accelerator-storage complex energies.** Mukhin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Peculiarities of neutrino detector operation at the accelerator-storage complex (ASC) energies, in particular, their angular characteristics are considered. The conclusion is made about perspectives of the calorimetric type neutrino detector utilization in studying neutrino processes at the ASC energies.

26826 (LBL—13500, pp 4.111-4.112) **Survey of instrumentation for environmental monitoring.** Quinby-Hunt, M.S.; Case, C.W.; McLaughin, R.D.; Morton, G.A.; Murphy, D.; Nero, A.V. Jr.; Quintanilha, A.T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division annual report, FY 1981.

This survey reviews three fundamental aspects of the problem: (1) environmental information; (2) analytical techniques; and (3) commercial instrumentaton. The first section provides an overview of the sources, characteristics, and effects of large numbers of pollutants and includes information on regulatory means of control. The second section describes and compares the analytical techniques used, including approved, on-going, and developing methods for sensitive, rapid, and accurate identification and quantitation of such pollutants. Problems which may be encountered with each technique are also reviewed. The third section covers instrumental techniques and provides information on commercially available instruments. Instrument notes give detailed descriptions of modes of operation, performance, and other information such as features, options, and cost.

26827 (MPI-PAE-EXP.EL—109) **Segmented scintillator-lead photon calorimeter using a double wavelength shifter optical readout system.** Fent, J.; Fessler, H.; Freund, P.; Gebauer, H.J.; Polakos, P.; Pretzl, K.P.; Schouten, T.; Seyboth, P.; Seyerlein, J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Nov 1982. 24p. Also published in Nucl. Instrum. Methods Phys. Res. (15 Jun 1983) v. 211(213) p. 315-322.

The construction and performance of a prototype scintillator-lead photon calorimeter using a double wavelength shifter optical readout is described. The calorimeter is divided into 4 individual cells each consisting of 44 layers of 3 mm lead plus 1 cm thick scintillator. The edges of each scintillator plate are covered by acrylic bars doped with a wavelength shifting material. The light produced in each scintillator plate is first converted in these bars, then converted a second time in a set of acrylic rods which run longitudinally through the calorimeter along the corners of each calorimeter cell. A photomultiplier is attached to each of these rods at the back end of the calorimeter. The energy resolution obtained with incident electrons in the energy range of 2-30 GeV is sigma/E $= 0.12/\sqrt{E}$. The uniformity of response across the front face of each cell was measured. Showers within each cell can be localised with an accuracy of better than sigma = 7 mm.

26828 (RL—82-087) **Track reconstruction in an inhomogeneous magnetic field for a polarised target experiment.** Maybury, R.; Daley, H.M. (Rutherford Appleton Lab., Chilton (UK)). Feb 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700946.

A program is described which was developed to reconstruct particle tracks through low mass magnetostrictive-readout spark chambers, optical spark chambers and multi-wire proportional chambers used in the fringe field of a polarised superconducting target magnet for an experiment designed to study the reaction $\pi^- p \rightarrow K^0 \Lambda$. The method uses weighted line fits to follow tracks distorted by the magnet field.

26829 (RL—83-010, pp 70) **Multilayers for soft x-ray analysis.** Arber, J. (Queen Mary Coll., London (UK). Dept. of Chemistry). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

26830 (TRI-PP—83-106) **Photon emission in self-quenching streamer chambers.** Salomon, M.; Webster, D.; Asano, D. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Oct 1983. 2p. (CONF-831015—43). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84900956.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

We have studied the properties of photons emitted by self-quenching streamer chambers. In particular the timing, intensity and wavelength distribution of these light pulses was measured with several gas mixtures.

26831 **Efficiency of a bismuth-germanate scintillator: comparison of Monte Carlo calculations with measurements.** Hsu, H.H.; Dowdy, E.J.; Estes, G.P.; Lucas, M.C.; Mack, J.M.; Moss, C.E. (Los Alamos Nat'l Laboratory, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 390-395(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Monte Carlo calculations of a bismuth-germanate scintillator's efficiency agree closely with experimental measurements. For this comparison, we studied the absolute gamma-ray photopeak efficiency of a scintillator (7.62 cm long by 7.62 cm in diameter) at several gamma-ray energies from 166 to 2615 keV at distances from 30.5 to 152.4 cm. Computer calculations were done in a three-dimensional cylindrical geometry with the Monte Carlo coupled photon-electron code CYLTRAN. For the experiment we measured 11 sources with simple spectra and precisely known strengths. The average deviation between the calculations and the measurements is 3%. Our calculated results also closely agree with recently published calculated results.

26832 **Performance of studies of Hamamatsu R647-01 photomultiplier.** Lo, C.C.; Leskovar, B.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 413-416(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Characteristics of the Hamamatsu R647-01 13 mm-diameter photomultiplier have been measured. Some typical photomultiplier characteristics-such as gain, dark current, transit and rise times-are compared with data provided by the manufacturer. Other photomultiplier characteristics, generally not available from the manufacturer, such as the single photoelectron time spread and pulse response for the full photocathode illumination were measured and are discussed. In particular the optimization of voltage divider for photomultiplier was investigated for timing applications in positron emission tomography systems.

26833 **Comparative lifetesting results for microchannel plates in windowless EUV photon detectors.** Malina, R.F.; Cobum, K.R. (Space Sciences Lab., Univ. of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 404-407(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Microchannel plates (MCP's) from seven manufacturers were subjected to a series of tests to determine their suitability for the Extreme Ultraviolet Explorer satellite. Comparative data are presented for sixteen MCP tandem pairs with channel length to diameter ratios (l/d's) ranging from 40:1 to 60:1 and for two saturable (curved channel) MCP's with l/d's of 80:1. Results for MCP's with

funnelled channel throats are also discussed. Properties of the MCP's which were monitored include: background count rate, output charge pulse height distribution (PHD), modal gain, PHD full width half maximum (FWHM), and extreme ultraviolet (EUV) photon quantum efficiency. Five detectors were chosen for further lifetime testing consisting of a mild bake to 100°C, and charge extraction to 10^{-2} coulombs, repeated high voltage cycling and reexposure to one atmosphere conditions. The results of these tests and their implications for the flight detectors are discussed. Erratic events in the detector background were recorded, probably due to field emission from high voltage surfaces or the absorption of water vapor into the electrode following exposure to air. The steps taken to control the detector background are discussed.

26834 **Characterization of a fast, sensitive gamma detector utilizing microchannel plate photomultiplier.** Kruse, H.W.; Hocker, L.P. (Los Alamos Nat'l. Lab., P.O. Box 1663, MSD410, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 387-389(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Sensitivity of a microchannel plate photomultiplier may be enhanced by coupling to Lucite or quartz with small sacrifice of time resolution. Sensitivity enhancement of a factor of 2.4 was achieved at the expense of an increase in time response from 288 ps FWHM to 330 ps. With such time resolution, amplitude resolution was observed to be 17% at 10 ma of output current and varied inversely as the square root of the current.

26835 **Light scattering from the substructure of bismuth germanate.** Unruh, W.P.; Murray, R.A. (Dept. of Physics and Astronomy, Univ. of Kansas, Lawrence, KS 66045). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 377-380(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Because of the difficulty of achieving exact stoichiometry during crystal growth, Bismuth Germanate crystals often contain particulates, bubbles and other inclusions. A more fundamental characteristic is the relatively large diffuse scattering exhibited in artificially-grown crystals, regardless of source, which results from fluctuations in stoichiometry during crystallization. One observes both the large fluctuations introduced by growth procedures and the microscopic fluctuations introduced thermodynamically. Scattering measurements may also be useful in determining whether nonstoichiometry on the microscopic level has any effect on the scintillation efficiency and performance of this material.

26836 **A high speed stabilized gated integrator.** Kastner, M. (Picker Internat'l., 12 Clintonville Rd., Northford, CT 06472). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 447-450(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A gated integrator is described which is suitable for variable integration time processing of NaI(Tl) scintillator pulses. When used in a gamma camera, this allows for a smooth transition between low and high count rate operation. The circuit can produce output rates above 400khz at input rates greater than 1 Mhz.

26837 **A solid state neutron detector.** Velbeck, K.; King, C.W.; Tawil, R.A. (The Harshaw Chemical Co., 6801 Cochran Rd., Solon, Ohio 44139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 360-361(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A solid state detector for thermal neutrons is described. The photodiode-scintillator front-end of this detector is integrated with its supporting electronics in a single package. The output signal is presented in analog and digital forms. A third digital output provides a signal that reflects the saturation of the electronics due to pulse pile-up. The persistence of pulse pile-up for periods greater than 1 millisecond may be related to the occurence of a criticality condition. The digital signals are provided on an RS-422 balanced differential line driver with a range, on twisted shielded pairs, of about 2000 feet. This device is stable over a wide range of temperatures.

26838 **Energy resolution enhancement of mercuric iodide detectors.** Finger, M.; Prince, T.A. (California Inst. of Technology, Pasadena, CA 91125). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 348-352(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A pulse processing technique has been developed which improves the gamma-ray energy resolution of mercuric iodide detectors. The technique employs a fast (100 ns) and a slow (6.4 μs) pulse height analysis to correct for signal variations due to variations in charge trapping. The capabilities of the technique for energy resolution enhancement are discussed as well as the utility of the technique for examining the trapping characteristics of individual detectors. We have achieved an energy resolution of 2.6% FWHM at 662 keV with an acceptance efficiency of 100% from a mercuric iodide detector which gives 8.3% FWHM using standard techniques.

26839 **Development of a portable microdosimetric radiation protection monitor covering a dynamic range of 120 dB above noise.** Arbel, A.; Booz, J.; Muller, K.D.; Neuhaub, H. (Israel Institute of Technology, Haifa). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 691-696(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A portable microdosimeter has been designed, covering a dynamic range of 120 dB in a single signal processing channel. A transistor is employed as non-linear element and deviation at low and high energies from a truly logarithmic characteristic is corrected by a microcomputer. A description of the basic design and experimental result are given.

26840 **A fast parallel encoding scheme for the Anger camera.** Seeger, P.A. (Los Alamos Nat'l Laboratory, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 274-280(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

In an Anger camera, only seven photomultipliers generally receive any significant signal from any one event; more distant tubes contribute only noise and background. The basic unit for two-dimensional position determination is thus a "receptive field" of seven photomultipliers. In the new encoding scheme, position determination is performed in two steps: first, the PM with the largest signal is identified, giving the coarse position. Then linear combinations of that signal and its six neighbors are used to interpolate within that receptive field. Since the analog sums are used only for interpolation, less precision is needed and faster electronics can be used. Speed is also increased by forming the linear combinations of all possible fields in parallel; this is done in a circuit called the "brain". Total time to digitize the position of an event is 400 ns; the precision is 1/26 of the photomultiplier spacing.

26841 **A position-sensitive germanium detector for gamma-ray astronomy.** Varnell, L.S.; Gonlding, F.S.; Jacobson, A.S.; Landis, D.A.; Ling, J.C.; Luke, P.N.; Madden, N.W.; Mahoney, W.A.; Pehl, R.H. (Jet Propulsion Laboratory, Pasadena, CA 91109). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 300-306(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The critical problem in high-resolution cosmic gamma-ray spectroscopy in the energy range from 0.02 to 10 MeV is the limited spectral sensitivity of the detectors used. This results from the small effective area of the detectors and the high background noise due to induced radioactivity and scattering in the detectors' high-energy particle environment. The effective area can be increased by

increasing the number of detectors, but this becomes prohibitive because of the size and expense of the resulting instrument. The authors have taken a new approach: a segmented large-volume germanium gamma-ray detector which can effectively discriminate against internal background yet maintain the high spectral resolution and efficiency of conventional coaxial Ge detectors. To verify this concept, a planar detector divided into two segments has been fabricated and laboratory measurements agree well with Monte Carlo calculations. A large coaxial detector which will be divided into five segments is being built using the techniques developed for the planar detector. Monte Carlo calculations show that the sensitivity (minimum detectable flux) of the segmented coaxial detector is a factor of 2-3 better than conventional detectors because of the reduction in the internal background.

26842 The development of a segmented N-type germanium detector, and its application to astronomical gamma-ray spectroscopy. Gehrels, N.; Cline, T.L.; Hewka, P.V.; Leventhal, M.; MacCullum, C.J.; Ryge, P.; Teegarden, B.J.; Tueller, J. (NASA/Goddard Space Flight Center, Greenbelt, MO 20771). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 307-311(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Extensive calculations and simulations have shown that the instrumental background in a coaxial germanium gamma-ray detector flown at balloon altitudes or in space, can be substantially reduced by segmenting the outer contact. The contact is divided into horizontal strips around the side of the detector, giving it many characteristics similar to those of a stack of planar detectors. By choosing different segment coincidence requirements in different energy ranges, one can obtain a factor of similar to 2 increase in sensitivity to spectral lines between 70 keV and 1 MeV, compared with an unsegmented detector. The reverse electrode configuration (using n-type germanium), with the p contact outside, is preferred for this application due to its thin dead layer and resistance to radiation damage in space. A small two-segment n-type coaxial detector has been developed and tested. To our knowledge, this is the first n-type germanium coaxial detector to be successfully made with a segmented cathode. Plans are to use the experience gained from the development of this prototype detector to contruct a large multisegment device.

26843 Large area mercuric iodide photodetectors. Iwanczyk, J.S.; Dabrowski, A.J.; Markakis, J.M.; Ortale, C.; Schnepple, W.F. (University of Southern California, Institute for Physics and Imaging Science, 4676 Admiraly Way, Suite 932, Marina del Ray, CA 90292). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 336-339(Feb 1984). (CONF-831015—). Contract AC08-83NV10282.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Results of an investigation of large area mercuric iodide (HgI_2) photodetectors are reported. Different entrance contacts were studied, including semitransparent metallic films and conductive liquids. Theoretical calculations of electronic noise of these photodetectors were compared with experimental results. HgI_2 photodetectors with active area up to 4 cm^2 were matched with NaI(Tl) and CsI(Tl) scintillation crystals and were evaluated as gamma-radiation spectrometers. Energy resolution of 9.3% for gamma radiation of 511 keV with a CsI(Tl) scintillator and energy resolution of 9.0% for gamma radiation of 622 keV with a NaI(Tl) scintillator have been obtained.

26844 Improved computerized acquisition and analysis of gamma ray spectra. Chapman, T.C.; Gross, J.M. (Idaho Nat'l. Engineering Lab., Exxon Nuclear Idaho Co., Inc., P.O. Box 2800, Idaho Falls, ID). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 150-153(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A new minicomputer based gamma spectroscopy system supports concurrent operation of up to four detectors, with 8k channels per detector. The minicomputer employs 896 kilobytes of RAM and a 25 megabyte hard disk, and runs under a multiuser operating system. Spectral analyses use algorithms adapted from the GAUSS V computer code and optimized for use on a minicomputer. Major improvements include peak location, baseline determination and background correction functions. Nuclide identification uses a library of up to 300 nuclides with up to 24 gamma lines for each nuclide. Upper limit values can be calculated for operator specified nuclides which are not detected by the measurement. Utilities available include nuclide library editing, energy calibration, efficiency calibration and graphic display of selected energy ranges from one or two spectra.

26845 A memory intensive functional architecture for distributed computer control systems. Dimmler, D.G. (Brookhaven Nat'l. Laboratory, Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 154-159(Feb 1984). (CONF-831015—). Contract AC02-76CH00016.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A memory-intensive functional architecture for distributed data-acquisition, monitoring, and control systems with large numbers of nodes has been conceptually developed and applied in several large-scale and some smaller systems. This discussion concentrates on the basic architecture; recent expansions of the architecture which now become feasible in view of the rapidly developing component technologies in microprocessors and functional large-scale integration circuits; implementation of some key hardware and software structures and one system implementation which is a system for performing control and data acquisition of a neutron spectrometer at the Brookhaven High Flux Beam Reactor. The spectrometer is equipped with a large-area position-sensitive neutron detector.

26846 An ultralow background germanium gamma-ray spectrometer. Reeves, R.H.; Brodzinski, R.L.; Hensley, W.K.; Ryge, P. (Pacific Northwest Lab., Richland, WA 99352). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 697-700(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The monitoring of minimum detectable activity is becoming increasingly important as environmental concerns and regulations require more sensitive measurement of the radioactivity levels in the workplace and the home. In measuring this activity, however, the background becomes one of the limiting factors. Anticoincidence systems utilizing both NaI(Tl) and plastic scintillators have proven effective in reducing some components of the background, but radiocontaminants in the various regions of these systems have limited their effectiveness, and their cost is often prohibitive. In order to obtain a genuinely low background detector system, all components must be free of detectable radioactivity, and the cosmic ray produced contribution must be significantly reduced. Current efforts by the authors to measure the double beta decay of Germanium 76 as predicted by Grand Unified Theories have resulted in the development of a high resolution germanium diode gamma spectrometer with an exceptionally low background. This paper describes the development of this system, outlines the configuration and operation of its preamplifier, linear amplifier, analog-to-digital converter, 4096-channel analyzer, shielding consisting of lead-sandwiched plastic scintillators wrapped in cadmium foil, photomultiplier, and its pulse generator and discriminator, and then discusses how the system can be utilized to significantly reduce the background in high resolution photon spectrometers at only moderate cost.

26847 Portable instrumentation for quantitatively measuring radioactive surface contaminations, including 90 Sr. Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA 99352). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 686-690(Feb 1984). (CONF-831015—). Contract AC06-76RL01830.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

This paper describes the development and application of portable instrumentation capable of quantitatively measuring most transuranics, activation products, and fission products, including Strontium 90, on almost any contaminated surface in nearly any location. Two germanium diode spectrometers, specifically adapted to portable, multipurpose use, provide measurement capability for both gamma rays and X rays. One is a large volume intrinsic germanium coaxial detector having a FWHM resolution of 1.82 KeV at the 1332 KeV line of Cobalt 60 and a relative efficiency of 32.8%. The other is a 2000 mm^2 planar intrinsic germanium detector housed in an end cap with a thin beryllium window and having a resolution of 739 eV at the 122 KeV line of Cobalt 57. Both crystals are mounted in 12-inch long end caps and attached to portable liquid nitrogen cryostats with nominal holding times of 16 hours. Data acquisition is normally accomplished with a 4096 channel analyzer and transferred to cassette tape for subsequent computer reduction and analysis. Data reduction is normally done with the aid of a PDP 11-44 computer either following "reading" of the data stored on tape or by direct connection to the laboratory-based computer. Transuranic elements can be identified and quantified on the basis of their characteristic K or L shell X-ray emission lines. The only difficulty in these procedures is obtaining suitable calibration data.

26848 **A portable gamma ray spectrometer/computer.** Roberts, H. (Canberra Industries, Inc. 45 Gracey Avenue Meriden, CT 06450). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 676-678(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A state-of-the-art portable gamma ray spectrometer has been developed commercially. The instrument is available with NaI or hand-held Germanium detectors and can collect and analyze up to 4K channels of PHA or MCS spectra. An integral LCD provides graphic and character readout. Dual microprocessors are operated in a tightly-coupled multi-programming environment providing unique operator interface capability.

26849 **A portable beta spectrometer/dosimeter.** Erkilla, B.H.; Brake, R.J.; Waechter, D.A. (Los Alamos Nat'l. Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 661-663(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

As part of an ongoing program to upgrade health and safety radiation survey instruments, the Los Alamos National Laboratory has developed a portable, battery-operated, computerized beta spectrometer/ dosimeter. The instrument will support many different detectors, but the one chosen here is a combination plastic scintillator and NaI crystal. The instrument includes pulse conditioning circuits, 128-channel pulse height analyzer with integral liquid crystal display, and a microcomputer system which calculates dose and dose rate from betas incident on the detector. Instrument operating life is about 8 hours between charges. The instrument will, at the user's option, display a beta spectrum or the accumulated dose in millirad, as well as give the user beta dose rates in millirad per hour. (At this point, the dosimetry algorithms are still under development.) Data accumulated in the instrument can be read out through a serial port on the instrument. The entire unit weighs 8 pounds, including internal batteries, and is packaged in a small case 25-cm long, 15-cm wide, and 15-cm high.

26850 **Characteristics of high-rate energy spectroscopy systems using HPGe coaxial detectors and time-variant filters.** Britton, C.L.; Becker, T.H.; Paulus, T.J.; Trammell, R.C. (EG & G Ortec, 100 Midland Rd., Oak Ridge, TN 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 455-460(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A high-rate, high-resolution gamma spectrometer system is described. The system consists of a reverse electrode HPGe coaxial detector, a transistor reset preamplifier, an active, semi-Gaussian prefilter, a gated integrator, and a unique data acquisition system consisting of a 10 μs, 13 bit ADC, fast FIFO memory, 8k by 23 bit data memory, and computer interface circuitry under the control of a Z-80A μP. The effects of the various components on the throughput are described and throughput data is presented. The resolution and peak shift for various shaping times are presented for count rates up to 1 Mcps input rate using a mixed ^{22}Na and ^{60}Co source. The low rate resolutions of ^{57}Co and ^{60}Co for various shaping times using either the semi-Gaussian or gated integrator output are discussed as well as the low energy resolution and peak shifts in the presence of high energy events.

26851 **A low-energy photon localization system for a tagged annihilation photon beam.** Argan, P.; Bloch, A.; Colin, G.; Tamas, G.; Vincent, E. (Departement de Physique Nucleaire a Haute Energie, CEN Saclay, 91191 Gif-sur-Yvette Cedex). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 138-140(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The purpose of this paper is to present a detector designed for the localization of the low energy photon. The so-tagged high energy photon can be used as an electromagnetic probe for any nuclear physics experiment. The detector consists of a stack of 16 modules; each module includes a multiwire proportional chamber and a plastic scintillator. The 48-wire chambers have a total detection surface of 96 X 115 mm^2. The matter necessary for photon conversion is introduced as a massive lead cathode. The gas in the chambers is a mixture of 75% argon, 25% isobutane, and 0.25% freon and methylal. The wires lead to 16 signal outputs per chamber and are connected to low-cost 8-channel hybrid FILAS circuits which consist of an amplifier, a discriminator, a shaper, and a coincidence with a common external gate which allows the data storage in 8 memories. The FILAS circuits are connected to a Schlumberger JCF-20 Camac module. The "OR" of the eight signals is used in coincidence with the signal of the associated scintillator to trigger the detector. Photons produce electromagnetic showers in the lead cathodes. The localization accuracy is downgraded by the multiple scattering of the shower particles in the lead foils; to minimize this effect without creating electrical or mechanical difficulties, the anode-cathode gap is 3 mm. A Monte Carlo simulation of the device and the annihilation photon tagging process are also presented.

26852 **Radiation stability of counting gas mixtures containing CF_4.** Valentine, K.H.; Guerrant, G.C.; Harter, J.A.; Kopp, M.K. (Instrumentation and Controls Division, Oak Ridge Nat'l. Laboratory, Oak Ridge, TN 37381). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 264-268(Feb 1984). (CONF-831015—). Contract W-7405-ENG-26.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Several noble gas mixtures containing CF_4 were irradiated at high neutron and gamma dose rates to determine their radiation stability for neutron flux monitoring applications where the total radiation dose can be large. Five test detectors (ionization and proportional counters employing either ^3He or ^{235}U as the sensitizing material) containing CF_4 gas mixtures were irradiated in a neutron flux of $\approx 10^{11}$ n X cm^{-2} X s^{-1} and a gamma field of $\approx 2 \times 10^8$ R/h. All detectors exhibited moderate to total degradation of pulse response at fluences from 10^{15} to 10^{16} n X cm^{-2}, with more rapid degradation occurring in the fission detectors. The pulse height degradation was probable caused by electron attachment on irradiation products such as C_2F_6, and C_3F_8, and CF_3OF, which were detected at 100- to 600-ppm levels in subsequent mass spectrometric analyses.

26853 **Review of the 3rd biennial conference on real-time computer applications in nuclear and particle physics.** O'Brien, D.W. (Lawrence Livermore Nat'l. Laboratory, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 178-179(Feb 1984). (CONF-831015—). Contract W-7405-ENG-48.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The topics presented at this conference, held in May 1983 at Berkeley, centered on computer technologies and architecture as they affect the data-acquisition and data-reduction process. Data-acquisition hardware activities were represented with discussions of CAMAC, FASTBUS, and specialized hardware for data sorting, pipelined operations, and parallel processing. Data-acquisition software and software systems and data-reduction and analysis software systems were presented and discussed, as were graphics, data-base management, networking, interactive techniques, and IC technologies, and their impact on scientific applications. This review summarizes the more important papers presented at the conference.

26854 **Semiconductor detectors and double beta decay.** Goulding, F.S.; Landis, D.A.; Luke, P.N.; Madden, N.W.; Malone, D.F.; Pehl, R.H.; Smith, A.R. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 285-299(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Theoretical physicists have devoted great effort to developing an adequate theory for linking the weak, electromagnetic, and strong forces of nature. Recent theoretical studies and observations of the stability of galaxies have strongly indicated the presence of large amounts of invisible mass. One element in the uncertainty associated with missing mass is the question of whether the neutrino has rest mass. A better understanding of the neutrino, explored in this paper by the possibility of double beta decay in the germanium 76 isotope, could perhaps provide some answers. Nuclear transitions are only energetically possible where the final nucleus is more tightly bound than its parent. The decay of germanium 76 to arsenic 76 is not energetically possible because the arsenic isotope is about 0.9 MeV less tightly bound than the germanium. The selenium 76 isotope, on the other hand, is about 2 MeV more tightly bound; therefore, a transition involving emission of two electrons by a germanium 76 nucleus to form a selenium 76 nucleus is energetically possible. The total energy release in kinetic energy of the beta particles and corresponding neutrinos from the excited daughter product is determined by the energy difference. This energetically possible event, if observed, will provide a breakthrough in understanding the universe. This paper discusses the underlying theory and a germanium detector experiment which could make such a contribution to the resolution of this question.

26855 **Current state of ring imaging Cherenkov detectors.** Coutrakon, G.B. (Fermi National Accelerator Lab P.O. Box 500 Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 27-31(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

This paper reviews several ring imaging Cherenkov detectors which are being used or developed to identify particles in high energy physics experiments. These detectors must have good detection efficiency for single photon-electrons and good spatial resolution over a large area. Emphasis is placed on the efficiencies and resolutions of these detectors as determined from ring imaging beam tests and other experiments. Following a brief review of the ring imaging technique, comparative evaluations are made of different forms of detectors and their respective materials.

26856 **Linearity and resolution of photodiodes.** van Driel, M.A.; Sens, J.C. (Stanford Linear Accelerator Center Stanford University, Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 83-86(Feb 1984). (CONF-831015—). Contract AC03-76SF00515.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Measurements are reported of the resolution and linearity of Hamamatsu S1337 Photodiodes mounted on a NaI crystal and exposed to electron energy deposits of up to 80 GeV. The results indicate that these diodes can replace photomultipliers in high-light-yield detectors such as NaI and BGO, when operated in multi-element, compact assemblies in the presence of a magnetic field.

26857 **Test of lead glass shower counters.** Ogawa, K.; Awaji, N.; Hayashii, H.; Iwata, S.; Ozaki, H.; Sugahara, R.; Takahasi, K.; Takasaki, F.; Tauchi, T. (Kek). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 79-82(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Lead glass counters made of wedge shaped blocks of SF6 were tested with positrons at SLAC. The beam energy ranged from 2-17.5 GeV. Energy dependence and beam position dependence of pulse height and energy resolution were studied with lead glass blocks of various lengths. The effect of a BK-7 light guide on pulse height was clearly observed. Degradation of the energy resolution due to aluminum absorbers of various lengths was investigated. A mesh type photomultiplier was also tested.

26858 **Investigation of dead times and dead zones in wire chambers operated in the self-quenching streamer mode.** Lingel, K.; del Guerra, A.; Mulera, T.; Perez-Mendez, T. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 89-93(Feb 1984). (CONF-831015—). Contract AC03-76SF00098.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The large saturated pulses of the type referred to as "self-quenching streamer" promise to provide an inexpensive method of radiation detection. The authors have continued investigations of the performance of wire chambers operating in this mode, with particular emphasis on measurements of dead times and dead zones. The results of these measurements and their effect on the application of such chambers in high rate environments and for digital gas sampling calorimetry are discussed.

26859 **Photoelectron range limitations to the spatial resolution for x-rays in gas proportional chambers.** Smith, G.C.; Fischer, J.; Radeka, V. (Brookhaven Nat'l. Laboratory, Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 111-115(Feb 1984). (CONF-831015—). Contract AC02-76CH00016.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Measurements have been made, for x-ray energies from a few keV to 18 keV, of the limiting spatial resolution caused by the finite range of the photoelectron, or electrons, created when an x-ray is absorbed in the gas of a proportional chamber. In hydrocarbon gases such as methane and ethane, where the photoelectron receives the bulk of the x-ray energy, the limiting spatial resolution is found to vary as a power law of x-ray energy. In argon and xenon, at an x-ray energy approximately twice that of the Ar/SUB K/ edge and the Xe/SUB L/ edge respectively, the measured limiting resolution is better than expected from an equivalent power law behavior.

26860 **Development of directional Cerenkov counters.** Dardo, M.; Morello, C.; Navarra, G. (Istituto di Cosmogeotisica del CNR Torino). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 32-34(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The performance of a test Cerenkov counter for determining the sense of motion of relativistic particles is described. The counter was tested with an electron beam at CERN and with cosmic ray muons. Results of these tests are presented and compared with theoretical expectations.

26861 **The plastic box - A 4π detector for intermediate energy heavy ion physics.** vanBibber, K.; Chan, Y.D.; Countryman, P.J.; Murphy, M.J.; Stokstad, R.G.; Tserruya, I.; Wald, S. (High Energy Physics Laboratory and Department of Physics Stanford University, Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 35-39(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A 4π array of plastic scintillator has been constructed and used in conjunction with high resolution solid state detectors. The array is employed principally to discriminate multinucleon transfer reactions from three-body (or more) final states. It should be useful for a broad class of experiments in which a global charged particle anticoincidence is required.

26862 **State of art of transition radiation detectors.** Yodh, G.B. (Dept. of Physics and Astronomy, Univ. of Maryland College Park, MD 20742). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 40-44(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Recent developments of transition radiation detectors for particle indentification, energy measurement beam monitoring and providing a tunable source for hard x-rays are surveyed.

26863 **Cherenkov and scintillation light measurements with scintillating glass, SGC1C.** Theodosiou, G.E.; Cox, B.; Komenenko, W.; Owen, D.; Selove, W.; Wagoner, D. (University of Pennsylvania, Dept. of Physics, Philadelphia, PA 19104). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 57-59(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors have been able to observe and measure both the direct Cherenkov (C) and the Scintillation (S) light components from scintillating glass, distinctly separated in time. This has important implications for hadron calorimetry, electron/hadron separation and low energy particle identification.

26864 **A measurement of the energy resolution and related properties of an SCG1-C scintillation glass shower counter array for 1-25 GeV positions.** Wagoner, D.E.; Conelti, S.; Cox, B.; Haire, M.; Hale, G.; Judd, D.J.; Mazur, P.O.; Murphy, C.T.; Rameika, R.; Turkot, F. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 53-56(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors report the measurement of the energy resolution of a 4 x 4 array of SCG1-C scintillation glass counters (Ohara Optical Glass Manufacturing Co., Ltd.) exposed to positrons in the energy range of 1 to 25 GeV. Each element of the array was 20.5 radiation lengths long. The resolution of the array was measured both with and without a 3.5 radiation length SCG1-C scintillation glass active converter and 0.2 radiation length hodoscopes used to measure shower position. They obtained an energy resolution $\sigma/E = (1.63 + 1.46/E)\%$ without the active converter and $\sigma/E = (0.64 + 3.94/\sqrt{E})\%$ with the active converter. Performing a partial correction for the average energy loss in the 0.2 radiation length hodoscopes resulted in an energy resolution of $\sigma/E = (0.50 + 3.43/\sqrt{E})\%$ for the active converter measurement. They also report on the measurement of the absolute number of photons produced by 1 GeV showers, the optical attenuation length for the light produced by showers, the fraction of the total light output that is due to Cerenkov light relative to scintillation light for showers, and the radiation darkening sensitivity of the scintillation glass.

26865 **Measurement of electronic shower position and size with a saturated avalanche tube hodoscope and a fine grained scintillation hodoscope.** Rameika, R.; Cox, B.; Hale, G.; Jenkins, C.M.; Judd, J.D.; Mazur, P.O.; Murphy, C.T.; Turko, F. (Fermi National Accelerator Laboratory, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 60-63(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A hodoscope has been constructed from 100 μ diameter wires and brass tubes (1.2 x 0.7 cm^2 cross section) filled with a mixture of argon, ethane and ethyl alcohol. It has been tested in the saturated avalanche mode in an SCG1-C electromagnetic shower detector to determine its properties for the measurement of the position and size of electromagnetic showers. Two of these tube hodoscopes were positioned 3.5 radiation lengths deep in the detector and the profiles of 1-25 GeV electromagnetic showers were measured. Simultaneous measurements were performed using a plane of twenty, 0.5 cm wide scintillation counters positioned immediately behind the gas tube hodoscope. In addition the transition between saturated avalanche and limited streamer modes has been measured for the tube hodoscopes.

26866 **Scintillating glass, fiber-optic plate detectors for active target and tracking applications in high energy physics experiments.** Ruchti, R.; Baumbaugh, B.; Bishop, J.; Biswas, N.; Cason, N.; Erichsen, R.; Kenney, V.; Kreymer, A.; Mountain, R. (Dept. of Physics, University of Notre Dame, Notre Dame, IN). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 69-73(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors have studied the performance of scintillating glass fiber-optic plates using 10 GeV/c particles at the SLAC test beam. The plates were composed of: Terbium activated claddedglass cores in a matrix of 15 μm spacing; and Cerium activated cladded-glass cores in a matrix of variable spacing 6-10 μm. The target plates were viewed with a three-stage, gatable image intensifier. Particle tracks and nuclear interactions were recorded on film for both materials. We observe 5 detected hits/mm for minimum ionizing particles for the Tb glass, and 1-2 hits/mm for the Ce glass. The test results indicate that scintillating glass fiber-optic plates can be used as high spatial resolution tracking detectors for both fixed target and colliding beam experiments.

26867 **Breakdown processes in wire chambers, prevention and rate capability.** Atac, M. (Fermi Nat'l. Accelerator Lab. P.O. Box 500 Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 99-106(Feb 1984).

Breakdowns were optically and electronically observed in drift tubes and drift chambers. They occur at a critical gain for given intensity in a gas mixture when ultraviolet photons are not completely quenched. It was observed that the breakdowns depended critically on average current for a given gas mixture independent of the size of the drift tubes used. Using 4.6% ethyl alcohol vapor mixed into 50/50 argon ethane gas, breakdowns are eliminated up to 7 μA average current drawn by pulses on a 1 cm section of an anode wire under an intense source. Pulses with an avalanche size of 10^6 electrons, rates above 10^6 pulses per centimeter per wire may be obtained with the elimination of breakdowns.

26868 **Signal and noise measurements for muons in scintillating glass with vacuum photodiode reading.** Kononenko, W.; Cox, B.; Owen, D.; Selove, W.; Theodosiou, G.E.; Van Berg, R. (University of Pennsylvania, Dept. of Physics, Philadelphia, PA 19104). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 136-137(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors have been able to measure 6 photoelectrons per MeV of energy loss in scintillating glass, SCG-1, using large area

vacuum photodiodes for readout with a signal to noise ratio of about 4.5.

26869 **Limited streamer-mode characteristics of a single-wire, cylindrical-cathode detector.** Margulies, S. (Dept. of Physics, University of Illinois at Chicago, Chicago, IL 60680). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 141-145(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Operating characteristics of the limited-streamer mode were investigated using a single-wire, cylindrical-cathode gas ionization detector. Among the data presented are pulse height as a function of voltage indicating the presence of two amplitude groups, evidence of afterpulsing, counting characteristics, and the dependence of efficiency on incident radiation rate.

26870 **A time-of-flight hodoscope saving the number of photomultipliers.** Bressani, T.; Caria, M.; Chiavassa, E.; Costa, S.; Dellacasa, G.; Iazzi, F.; Minetti, B.; Serci, S. (Dipartimento di Scienze Fisiche, Universita di Cagliari, 09100 Cagliari). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 146-149(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Results of measurements of the performances of a time-of-flight hodoscope consisting of 16 slabs of plastic scintillator, 90x4x1 cm^3 each, viewed by only 8 (instead of 32) photomultipliers are described. The slabs are coupled to the photomultipliers in such a way that they are considered as the elements of a square matrix of rank 4. Thus only 2x4 photomultipliers are needed to identify unambiguously each of the 16 slabs, if only a particle at a time has to be detected. By means of a very simple electronics, the authors obtained a local time-of-flight resolution of 570 ps fwhm and a spatial resolution along each slab of 5 cm fwhm. The cross-talk due to unrecognized events was less than 5%.

26871 **Multiple-independent detector system.** Seeger, P.A. (Los Alamos Nat'l. Laboratory, Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 160-161(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The Weapons Neutron Research (WNR) facility has several neutron diffraction and scattering instruments which use arrays of ^{3}He-filled proportional counters to detect thermal and epithermal neutrons and to measure time of flight. A Multiple-Independent Detector System (MIDS) has been developed with emphasis on high speed, low cost, modularity, and simplicity. Dead time for one detector channel is 400 ns, and system throughput may be 6 MHz. Cost is $200 per detector, including amplifiers, multiplexers, and time analysis. Modules include individual shaping preamps for each detector, a 32-channel discriminator/multiplexer, a family of second-level multiplexers incorporating line drivers, an 8-bit optoisolated latch, and a time-of-flight clock which concatenates time and detector information and interfaces through CAMAC to a data-acquisition system. Four systems are now in operation, with 25 to 100 detectors each.

26872 **Review of recent fastbus developments.** Walz, H.V. (Stanford Linear Accelerator Center, Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 205-210(Feb 1984). (CONF-831015—). Contract AC03-76SF00515.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The status of the FASTBUS Specification for modular data acquisition and control systems is reviewed. Recent developments at research laboratories and available support from commercial manufacturers are highlighted. Covered are hardware developments and system implementations in the U.S.A., Canada and Japan.

26873 **A digital pulse-shape discriminating unit for neutron-gamma discrimination with NE213.** Kumahara, T.; Tominaga, H. (Japan Atomic Energy, Research Inst., Tokai-Mura, Nakagun, Ibaraki-ken, 319-11). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 451-454(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A fast and stable digital pulse-shape discriminating unit has been developed for the moisture gauge using ^{252}Cf as radiation source. This unit performs digital discrimination between neutrons and gamma-rays in conbination with the liquid scintillator NE213. Modern digital integrated circuits such as flash type A-D converter, a digital divider, a digital comparator and digital controlled gated integrators compose the discrimination circuit. Neutrons and gamma-rays events are separately accumulated and applied for automatic stabilization by an integrated single-chip computer. The discriminating characteristics are controlled not only manually but also under a host computer by way of the GPIB. The performances of available event rates and long term stability are estimated around 100 kcps and 0.5 % respectively. The actual circuit configuration and features are discussed in detail.

26874 **A passive neutron counter for determination of transuranics in high gamma activity samples.** Rogers, L.A.; Brodzinski, R.L.; Brown, D.P. (Pacific Northwest Lab., Richland, WA 99352). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 672-675(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The measure of transuranic content in nuclear waste is complicated by the fact that transuranics include a broad spectrum of radioactive decays without any features in common. This paper describes a very sensitive neutron counting instruments which can determine the presence of small quantities of transuranic materials in samples emitting extremely high levels of gamma radiation and which can also determine the isotopic content. The detector is modular to facilitate disassembly for maintenance or decontamination and consists of a neutron counter with internal and external radiation shields. The external shield, designed to minimize the ambient neutron background, is an annular tank containing a saturated aqueous solution of boric acid. The counter module is an annular array of 80 BF_3 proportional counting tubes arranged in two concentric rows of 40 tubes surrounded by a polyethyene moderator. The internal shield, a lead annulus 10 cm thick, separates the sample chamber from the detector array. The sample chamber accepts a five-gallonbucket sized sample. Gamma radiation levels of greater than 100,000 R/hr can be tolerated without affecting the neutron count rate. Each tube is fitted with a preamplifier/discriminator so that the entire array can operate in the same gamma environment as a single tube. The electronics permits measurements in a coincidence mode, for isotopic composition measurement, and a spatial mode, for determining the physical distribution of transuranics in the sample.

26875 **Use of layer strains in strained-layer superlattices to make devices for operation in new wavelength ranges, E.G., InAsSb at 8 to 12 μm.** Osbourn, G.C. (to Dept. of Energy). US Patent Application 6-539,367. 6 Oct 1983. 25p. Contract AC04-76DP00789.

An intrinsic semiconductor electro-optical device comprises a p-n junction intrinsically responsive, when cooled, to electromagnetic radiation in the wavelength range of 8 to 12 μm. This radiation responsive p-n junction comprises a strained-layer superlattice (SLS) of alternating layers of two different III-V semiconductors. The lattice constants of the two semiconductors are mismatched, whereby a total strain is imposed on each pair of alternating semiconductor layers in the SLS structure, the proportion of the total strain which acts on each layer of the pair being proportional to the ratio of the layer thicknesses of each layer in the pair.

26876 **Methods for deconvoluting and interpreting complex gamma- and x-ray spectral regions.** Gunnick, R. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **45**: 218-219(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

26877 **Application of solid state track recorder neutron dosimetry for Three Mile Island Unit 2 reactor recovery.** Gold, R.; Ruddy, F.H.; Roberts, J.H.; Preston, C.C.; Ulseth, J.A.; McElroy, W.N.; Leitz, F.J.; Hayward, B.R.; Schmittroth, F.A. (Westinghouse Hanford Co., Richland, WA (USA)). *Nuclear Tracks;* 7: No. 1-2, 13-30(1983). (CONF-820762—).

From 5. meeting of the Pacific Northwest working Group on nuclear track registration; Richland, WA, USA (28 Jul 1982).

Application of neutron dosimetry for assessment of fuel distribution throughout the Three Mile Island-2 (TMI-2) reactor core region and the primary coolant system is advanced. Neutron dosimetry in the reactor cavity, i.e. the cavity between the pressure vessel and the biological shield, could provide data for the assessment of the core fuel distribution. A more immediate task entails locating and quantifying the amount of fuel debris in the ex-core primary coolant system in the range of 1 to 1000 kg. Solid state track recorder (SSTR) neutron dosimetry is considered for such exploratory scoping experiments at TMI-2. The sensitivity of mica-^{235}U (asymptotically thick) SSTR has been ascertained for such environments. For plausible geometric assumptions and environmental conditions, it has been demonstrated that the SSTR method has adequate sensitivity to properly respond and detect fuel quantities of the order of 1 kg in the ex-core primary coolant system.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 26752, 26852

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 25248, 25273, 25522, 25913, 26738, 26775, 26911, 27266

26878 (LBL—13500, pp 4.90-4.92) **Two-point Rayleigh scattering measurements in a V-shaped turbulent flame.** Namazian, M.; Talbot, L.; Robben, F. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The objective of this work is to apply the Rayleigh scattering technique for density measurements at two points in turbulent flames. We used two independent sets of scattered-light collection optics and a method of splitting the laser beam and varying the separation of the two sampled points. Representative results have been obtained in a grid-generated turbulent flame corresponding to the wrinkled laminar flame region, as defined by the Reynolds and Damkohler numbers. Spatial and time-space correlations of the density were obtained 85 mm downstream from the grid in three orthogonal directions. The density fluctuation structures of this flame and their development are discussed.

26879 (RL—83-010, pp 85-111) **Evaluation of highly polished surface quality using grazing incidence soft X-ray reflection and scattering.** Herring, J.R.H. (Birmingham Univ. (UK)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

Soft X-radiation, in particular the Al-K line at 8.34 A, is a useful tool in the measurement of surface roughness on the scale of a few angstroms. The method used is based upon precise measurements of the intensity and arc second angular distribution of the X-rays reflected at 1°-2° from small optical flats. The analysis uses a simple method of inferring the presence of roughness on more than one scale of correlation length. Effort has concentrated on the problems involved in accuracy and reproducibility of results, and this paper describes how the sources of initial variability and unexpected trends in the data have been traced to experimental details such as detector window inhomogeneities, mechanical instability and the effect of dust residing on the test surfaces. The latter is most noticeable at long wavelengths.

26880 (RL—83-010, pp 2-35) **Current status of grazing incidence optics.** Aschenbach, B. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

The developments in the area of grazing incidence optics with emphasis on telescopes for use in X-ray astronomy are reviewed. The performance of existing high-resolution telescopes is outlined and compared with those expected from future missions like ROSAT and AXAF. Starting from the basic principles of X-ray reflection and scattering, an attempt is made to highlight the current understanding of X-ray mirror physics using new theoretical ideas as well as experimental laboratory results.

26881 (RL—83-010, pp 36-49) **Current status of x-ray and XUV replica optics.** Korte, P.A.J. de (Rijksuniversiteit Leiden (Netherlands)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

A description of the replica technique, used for the production of the Wolter I telescope for the European X-ray Observatory EXOSAT, is given. Those parameters influencing the replication process are highlighted, separately. Special attention is given to the long term stability of the replica optics and its dependence on epoxy characteristics.

26882 (RL—83-010, pp 50-69) **Design of multilayer coatings for soft x-rays and their application for imaging and spectroscopy.** Spiller, E. (IBM Watson Research Center, Yorktown Heights, NY (USA)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

It is now possible to deposit multilayer films with boundaries that are essentially smooth on an atomic scale. These films can be used as optical elements in a similar way as interference coatings are used for visible light. The fact that all materials are absorbing for soft x rays requires coating designs which are different from their all dielectric counterparts for visible light. The design possibilities and limitations for x-ray multilayers will be discussed and the results compared with experimental data. The applications of the coatings to spectroscopy will be discussed. The coatings make it possible to obtain substantial reflectivities for soft x rays near normal incidence. This allows the use of normal incidence optics for x-ray microscopes and telescopes with substantially higher resolution than is possible with grazing incidence optics.

26883 (RL—83-010, pp 71-74) **Mirror benders for high thermal loading.** Bailey, W.; Vickery, A.P. (ASTRON Developments Ltd., Hounslow (UK)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

The thermal conditions in high power mirrors can be very complex and the exact calculation of their thermal behaviour requires very detailed calculations; however by making some simplifying assumptions it is possible to make an analysis which indicates the sort of performance that can be expected. Further, by consideration of the simplifying assumptions, it is possible to see how the design may contain features to mitigate the effects that occur in the real world. A simple treatment of thermal perturbations in mirror benders is presented. The design features which can help a bender to operate with a high thermal flux are looked at. In conclusion, the way to proceed to higher thermal loadings when passive methods prove inadequate is suggested.

26884 (RL—83-010, pp 75-83) **Machine for figuring long X-ray optical elements.** Lindsey, K. (National Physical Lab., Teddington (UK)); McCombie, A.; Paul, D.; Stanley, V.; Vickery, A. (ASTRON Developments Ltd., Hounslow (UK)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

A new machine has been developed for the machining, lapping and polishing of mirror elements for use with grazing incidence radiation. The mirrors have ranged from small flat mirrors - elastically bent to focus X-rays in crystallographic applications - large conicoidal surfaces of revolution typified by the X-ray telescope mirrors used in rocket or satellite borne space astronomy experiments. Of particular interest to many users of X-ray mirrors are those configured as sectored elements.

26885 (RL—83-010, pp 84) **Diamond turned X-ray optical systems for high sensitivity X-ray astronomy.** Culhane, J.L. (University Coll., London (UK). Mullard Space Science Lab.); Catura, R.C. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

26886 (RL—83-010, pp 135-151) **SERC/CUPE ultra precision CNC diamond turning machine for X-ray mirrors.** Wills-Moren, W.J. (Cranfield Unit for Precision Engineering, Bedford (UK)). 1983. NTIS (US Sales Only), PC A08/MF A01. (CONF-8207106—).

From Symposium on new techniques in X-ray and XUV optics; Abingdon, UK (29 Jul 1982).

In December 1979, the Science and Engineering Research Council (SERC) commissioned Cranfield Unit for Precision Engineering (CUPE) to manufacture and develop a CNC diamond turning machine for the manufacture of X-ray mirrors up to 1.4 m internal diameter and 0.6 m axial length. This machine is now in operation in the CUPE laboratories and will ultimately be housed in a specially built temperature controlled enclosure at Cranfield and operated on behalf of SERC. This paper describes the machine and gives an indication of initial machining performance.

26887 **(SAND—83-1766C) Instrumenting and interpreting the time-varying response of structural systems.** Walter, P.L. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 23p. (CONF-8406101—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009067.

From 5. international congress on experimental mechanics; Montreal, Quebec, Canada (10 Jun 1984).

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The dynamic testing performed on structural systems sometimes lacks specific objectives. In addition, the design of the measurement system intended to record the resultant data often does not receive adequate attention. This article presents the rationale for performing dynamic testing and provides insight for selecting transducers and determining their mounting locations to measure the resultant structural motion. Response measurements from transducers mounted on a freely-suspended bar structure are illustrated and explained. These results are generalized to more complex structures comprised of rod, plate, bar, and shell elements of varying geometries, boundary conditions, and materials.

26888 **(UCRL—53447) Analysis of moisture in solids: a review of the last decade, or from Pande to the present.** Pyper, J.W. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1983. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011166.

The scientific literature published since A. Pande's comprehensive monograph Handbook of Moisture Determination and Control (1974) was surveyed (to mid-1983) for new or improved techniques of analyzing moisture in solids. Particular focus was on methods that might distinguish between bound and free moisture in organic solids. The classification of moisture is discussed, as well as pitfalls in sampling, in sample handling, and in the comparison of different methods. Four methods that show promise of being able to distinguish between bound and free moisture were identified: dielectric spectrometry, coherent microwave analysis, near-infrared reflectance analysis (NIRA), and nuclear magnetic resonance spectroscopy (NMR). 81 references.

26889 **Application of artificial intelligence to triple quadrupole mass spectrometry (TQMS).** Wong, C.M.; Crawford, R.W.; Kehler, T.P.; Kunz, J.C. (Lawrence Livermore Nat'l. Lab., Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 804-810(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

At Lawrence Livermore National Laboratory the authors have designed a totally computerized triple quadrupole mass spectrometer with the ultimate goal of using it as a prototype for "knowledge-based" instrument control. As an "intelligent" instrument, with its computer-based data acquisition and control system, it has the ability to learn and respond quickly. The intelligence is encoded in the system using the representation and rule-based reasoning heuristic techniques of Artificial Intelligence. These techniques are used to encode heuristic knowledge, or the intuition, formal and informal rules, and experiential knowledge that the human expert normally uses to make decisions and arrive at solutions in a specific domain problem. In this specific case, the knowledge the authors are encoding is a tuning procedure for the spectrometer, including heuristics to describe a self-adaptive, feedback control process for real-time optimization or tuning of the data acquisition procedure throughout the entire data collection process.

26890 **Improved gaseous leak detector.** Juravic, F.E. Jr. (to Dept. of Energy). US Patent Application 6-539,369. 6 Oct 1983. 21p. Contract AC02-76CH03000.

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In a short path length mass-spectrometer type of helium leak detector wherein the helium trace gas is ionized, accelerated and deflected onto a particle counter, an arrangement is provided for converting the detector to neon leak detection. The magnetic field of the deflection system is lowered so as to bring the nonlinear fringe area of the magnetic field across the ion path, thereby increasing the amount of deflection of the heavier neon ions.

26891 **Thermoacoustic couple.** Wheatley, J.C.; Swift, G.W.; Migliori, A. (to Dept. of Energy). US Patent Application 6-539,013. 4 Oct 1983. 15p. Contract W-7405-ENG-36.

An apparatus and method for determining acoustic power density level and its direction in a fluid using a single sensor are disclosed. The preferred embodiment of the apparatus, which is termed a thermoacoustic couple, consists of a stack of thin, spaced apart polymeric plates, selected ones of which include multiple bimetallic thermocouple junctions positioned along opposite end edges thereof. The thermocouple junctions are connected in series in the nature of a thermopile, and are arranged so as to be responsive to small temperature differences between the opposite edges of the plates. The magnitude of the temperature difference, as represented by the magnitude of the electrical potential difference generated by the thermopile, is found to be directly related to the level of acoustic power density in the gas.

26892 **Digital rotation measurement unit.** Sanderson, S.N. (to Dept. of Energy). US Patent Application 6-538,059. 30 Sep 1983. 26p. Contract AC04-76DP00789.

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A digital rotation indicator is disclosed for monitoring the position of a valve member having a movable actuator. The indicator utilizes mercury switches adapted to move in cooperation with the actuator. Each of the switches produces an output as it changes state when the actuator moves. A direction detection circuit is connected to the switches to produce a first digital signal indicative of the direction of rotation of the actuator. A count pulse generating circuit is also connected to the switches to produce a second digital pulse signal having count pulses corresponding to a change of state

of any of the mercury switches. A reset pulse generating circuit is provided to generate a reset pulse each time a count pulse is generated. An up/down counter is connected to receive the first digital pulse signal and the second digital pulse signal and to count the pulses of the second digital pulse signal either up or down depending upon the instantaneous digital value of the first digital signal whereby a running count indicative of the movement of the actuator is maintained.

26893 **Method and apparatus for measuring response time.** Johanson, E.W.; August, C. (to Dept. of Energy). US Patent Application 6-522,282. 11 Aug 1983. 12p. Contract W-31-109-ENG-38.

A method of measuring the response time of an electrical instrument which generates an output signal in response to the application of a specified input, wherein the output signal varies as a function of time and when subjected to a step input approaches a steady-state value, comprises the steps of: (a) applying a step input of predetermined value to the electrical instrument to generate an output signal; (b) simultaneously starting a timer; (c) comparing the output signal to a reference signal to generate a stop signal when the output signal is substantially equal to the reference signal, the reference signal being a specified percentage of the steady-state value of the output signal corresponding to the predetermined value of the step input; and (d) applying the stop signal when generated to stop the timer.

26894 **Helical screw viscometer.** Aubert, J.H.; Chapman, R.N.; Kraynik, A.M. (to Dept. of Energy). US Patent Application 6-509,758. 30 Jun 1983. 18p. Contract AC04-76DP00789.

A helical screw viscometer for the measurement of the viscosity of Newtonian and non-Newtonian fluids comprising an elongated cylindrical container closed by end caps defining a circular cylindrical cavity within the container, a cylindrical rotor member having a helical screw or ribbon flight carried by the outer periphery thereof rotatably carried within the cavity whereby the fluid to be measured is confined in the cavity filling the space between the rotor and the container wall. The rotor member is supported by axle members journaled in the end caps, one axle extending through one end cap and connectable to a drive source. A pair of longitudinally spaced ports are provided through the wall of the container in communication with the cavity and a differential pressure meter is connected between the ports for measuring the pressure drop caused by the rotation of the helical screw rotor acting on the confined fluid for computing viscosity.

26895 **Omnidirectional fiber optic tiltmeter.** Benjamin, B.C.; Miller, H.M. (to Dept. of Energy). US Patent Application 6-509,555. 30 Jun 1983. 12p. Contract AC04-76DP00789.

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A tiltmeter is provided which is useful in detecting very small movements such as earth tides. The device comprises a single optical fiber, and an associated weight affixed thereto, suspended from a support to form a pendulum. A light source, e.g., a light emitting diode, mounted on the support transmits light through the optical fiber to a group of further optical fibers located adjacent to but spaced from the free end of the single optical fiber so that displacement of the single optical fiber with respect to the group will result in a change in the amount of light received by the individual optical fibers of the group. Photodetectors individually connectd to the fibers produce corresponding electrical outputs which are differentially compared and processed to produce a resultant continuous analog output representative of the amount and direction of displacement of the single optical fiber.

26896 **X-ray beam finder.** Gilbert, H.W. (to Dept. of Energy). US Patent Application 6-504,905. 16 Jun 1983. 13p. Contract AC04-76DP00789.

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An X-ray beam finder for locating a focal spot of an X-ray tube includes a mass of X-ray opaque material having first and second axially-aligned, parallel-opposed faces connected by a plurality of substantially identical parallel holes perpendicular to the faces and a film holder for holding X-ray sensitive film tightly against one face while the other face is placed in contact with the window of an X-ray head.

26897 **Rotational viscometer for high-pressure, high-temperature fluids.** Carr, K.R. (to Dept. of Energy). US Patent Application 6-501,313. 6 Jun 1983. 12p. Contract AC05-84OR21400.

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The invention is a novel rotational viscometer which is well adapted for use with fluids at high temperatures and/or pressures. In one embodiment, the viscometer include a substantially nonmagnetic tube having a closed end and having an open end in communication with a fluid whose viscosity is to be determined. An annular drive magnet is mounted for rotation about the tube. The tube encompasses and supports a rotatable shaft assembly which carries a rotor, or bob, for insertion in the fluid. Affixed to the shaft are (a) a second magnet which is magnetically coupled to the drive magnet and (b) a third magnet. In a typical operation, the drive magnet is rotated to turn the shaft assembly while the shaft rotor is immersed in the fluid. The viscous drag on the rotor causes the shaft assembly to lag the rotation of the drive magnet by an amount which is a function of the amount of viscous drag. A first magnetic pickup generates a waveform whose phase is a function of the angular position of the drive magnet. A second magnetic pickup generates a waveform whose phase is a function of the angular position of the third magnet. Means are provided to generate an output indicative of the phase difference between the two waveforms. The viscometer is comparatively simple, inexpensive, rugged, and does not require shaft seals.

26898 **Plasma discharge elemental detector for a mass spectrometer.** Heppner, R.A. (to Dept. of Energy). US Patent Application 6-500,717. 3 Jun 1983. 45p.

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A material to be analyzed is injected into a microwave-induced plasma discharge unit, in which the material is carried with a flow of buffer gas through an intense microwave energy field which produces a plasma discharge in the buffer gas. As the material exits from the plasma discharge, the material is sampled and conveyed along a capillary transfer tube to a mass spectrometer where it is analyzed. The plasma discharge causes dissociation of complex organic molecules into simpler molecules which return to the neutral ground state before they are analyzed in the mass spectrometer. The buffer gas is supplied to one end portion of the discharge tube and is withdrawn from the other end portion by a vacuum pump which maintains a subatmospheric pressure in the discharge tube. The sample material is injected by a capillary injection tube into the buffer gas flow as it enters the plasma discharge zone. The dissociated materials are sampled by an exial sampling tube having an entrance where the buffer gas exits from the plasma discharge zone. The sample material may be supplied by a gas chromatograph having a capillary effluent line connected to the capillary injection tube, so that the effluent material is injected into the microwave induced plasma discharge. The microwave field is produced by a cavity resonator through which the discharge tube passes.

26899 **Portable instrument and method for detecting reduced sulfur compounds in a gas.** Gaffney, J.S.; Kelly, T.J.; Tanner, R.L. (to Dept. of Energy). US Patent Application 6-500,106. 1 Jun 1983. 10p. Contract AC02-76CH00016.

A portable real time instrument for detecting concentrations in the part per billion range of reduced sulfur compounds in a sample gas. Ozonized air or oxygen and reduced sulfur compounds in a sample gas stream react to produce chemiluminescence in a reaction chamber and the emitted light is filtered and observed by a photomultiplier to detect reduced sulfur compounds. Selective response to individual sulfur compounds is achieved by varying reaction chamber temperature and ozone and sample gas flows, and by the use of either air or oxygen as the ozone source gas.

26900 **InP:Fe photoconductors as photodetectors.** Hammond, R.B.; Paulter, N.G.; Wagner, R.S.; Springer, T.E.; Mac Roberts, M.D.J. (Los Alamos National Lab., NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* **ED-30**: No. 4, 412-415(Apr 1983).

Impulse response measurements of photoconductors fabricated from Fe-doped, semi-insulating InP crystals are described. Results show purely exponential decay transients with decay times which are inversely related to Fe concentrations. Photoconductive gains as high as 5 have been demonstrated in photoconductors with AuGe and AuSn contacts. Response times from 150 to 1000 ps are observed.

26901 **Calorimetric test facility for field measuring thermal performance of passive/hybrid solar components.** McCabe, M.E.; Lecourte, J.; Robinson, S. (Building Equipment Division, National Bureau of Standards, Washington, DC). pp 673-686 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Studies of the thermal performance of passive solar buildings have indicated a need for precise field measurement of solar heat gain and thermal heat loss or gain for modular passive/hybrid solar components. A description of the conceptual design and the major assemblies and subsystems for a new calorimetric test facility is presented in this paper. The facility is designed for field testing of passive solar components at the National Bureau of Standards in Gaithersburg, MD. It is anticipated that the test facility will provide a substantial improvement in the field measuring techniques for passive and hybrid solar components over the test cells currently in use and thereby provide a firm technical basis from which laboratory test procedures can be evaluated. Computer studies of the thermal performance of the metering chamber assembly made with a 65-node finite-difference thermal model are described. The model was used to compute the heat balance for the solar absorber panel and the air-conditioning units, located in the metering chamber. Design days in both summer and winter were studied for a worst-case test article, which consisted of a single sheet of window glass. A description of the passive/hybrid solar components proposed for testing in the calorimeter during the winter season of 1982-1983 is also provided.

26902 **Acceptance testing of the NBS calibrated hot box.** Jones, R.R. (National Bureau of Standards, Gaithersburg, Maryland). pp 687-702 of Proceeding of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

This paper describes the acceptance testing requirements for a new calibrated-hot-box facility at the National Bureau of Standards designed to permit simultaneous measurement of heat, moisture, and airflow in wall constructions while subjected to dynamic ambient conditions. The performance requirements specified for the calibrated hot box wall tester and the performance tests required for final acceptance are discussed. Precision and accuracy considerations are set forth. The paper also proposes potential avenues of research and the issues related to carrying out a comprehensive testing program for evaluation of the performance of wall sections.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 26499, 26740

26903 **(LA—9999-MS) Toxicological study of the high-explosive formulation imidazo(4,5-d)imidazole-2,5(1H,3H)-dione, tetrahydro-1,4-dinitro.** London, J.E.; Smith, D.M. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010999.

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The acute oral LD_{50} values for the high-explosive formulation imidazo(4,5-d)imidazole-2,5(1H,3H)-dione, tetrahydro-1,4-dinitro (DINGU) for mice and rats are greater than 5 g/kg. According to classical guidelines, the mixture would be considered only slightly toxic or practically nontoxic in both species. Skin application studies in the rabbit with DINGU demonstrated that it was cutaneously nonirritating. This material was also nonirritating in rabbit eye application studies. The sensitization study in the guinea pig did not show DINGU to be deleterious in this regard.

26904 **(SAND—84-0135C) Methods for predicting rubble motion during blasting.** Schamaun, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 11p. (CONF-840633—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008026.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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Recent applications of explosives and blasting agents to rubble rock have led to requirements for more elaborate design and analysis methods. In most blasting uses, it is necessary not only to fracture the rock, but also to move the broken rubble in a predictable manner. Many in situ extraction techniques require rubblization to take place in a confined region where rock motion is a predominate factor in creating a permeable broken bed. In this paper, two analytical methods are presented which describe the large rubble motion during blasting. These methods provide the blast designer with a tool for evaluation and further refinement of blasting patterns and timing sequences.

26905 **(SAND—84-0188C) Design and testing of an explosion product fabric containment enclosure.** Wolf, D.F.; Widdows, H.E.; Holt, I.T. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 3p. (CONF-840496—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008849.

From 8. AIAA aerodynamic decelerator and balloon technology conference; Hyannis, MA, USA (2 Apr 1984).

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A fabric enclosure required to contain explosion products long enough to allow air sampling experiments to be completed was designed and tested at Sandia National Laboratories. The enclosure was fabricated of nylon cloth panels joined with slide fasteners (zippers) for rapid assembly under a variety of test conditions. Several tests were conducted during which the enclosure remained intact and allowed air sampling experiments to be completed as planned.

26906 **(SAND—84-0297C) Airblast predictions with meteorological and microbarograph measurements. Project DIRECT COURSE.** Reed, J.W.; Church, H.W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 43p. (CONF-8404129—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009932.

From DNA direct course symposium; Adelphi, MD, USA (9 Apr 1984).

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Recent explosion tests have demonstrated elements of anomalous behavior, in both airblast propagation and cloud growth, that could not be easily explained by routinely available meteorological observations made at shot time. To better detail the near-field at-

mospheric structure during DIRECT COURSE tests at White Sands Missile Range (WSMR), additional measurement systems were employed in hope of aiding interpretation of any further anomalies that might occur. Besides regular WSMR rawinsonde balloon (raob) measurements launched from SOTIM-3 site, WSMR also provided a mobile 23 m meteorological tower equipped for continuous recording of wind and temperature at three levels. Sandia operated its Tethersonde to give a succession of ascending and descending recordings of wind, temperature, moisture, and pressure heights to above 800 m above ground. Finally, an experimental Doppler-laser remote sensing system was operated by NOAA, with results given in another presentation at this symposium. As with other large explosion tests, a weather-watch and blast prediction service was provided during the countdown, to provide warning to the Test Director of any possible damaging or hazardous airblast propagations to great distances. Six microbarograph (MB) stations were operated in various communities to document the actual airblast wave passage, for use in verifying predictions as well as in validation or rejection of any damage claims that resulted.

26907 **(UCID—19978) Grueneisen parameter measurements for high explosives.** Bloom, G.H.; Claar, J.H. (Lawrence Livermore National Lab., CA (USA)). 27 Dec 1983. Contract W-7405-ENG-48. 61p. NTIS, PC A04; 3; GPO Dep. Order Number DE84008863.

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The Mie-Grueneisen equation of state $P - P_0 = \Gamma (E - E_0)$ rho is often used to describe the behavior of materials under pressure. P is the pressure, E is the specific internal energy, and rho is the material density. More specifically, the Grueneisen parameter $\Gamma = 1/\text{rho}\ (\partial P/\partial E)v$ is useful in determining the response of materials to rapid heating at constant volume. The Grueneisen parameter is dimensionless. The Grueneisen parameter can be calculated from lattice dynamics, from thermoelastic constants or from shock-wave data. There is good agreement on the values for metals. Not much work has been done on other materials. In some cases the value of Γ may be uncertain by an order of magnitude. This has prompted us to measure the Grueneisen coefficient for two high explosives of interest to use: PBX-9404 (94% HMX) and RX-03-BB (92.5% TATB), at both full and reduced density. This work is a continuation of an earlier study and represents a significant improvement in accuracy as well as extension to the reduced density materials. Our results are summarized in the tables at the end of this report.

26908 **(UCRL—90142) Dynamic powder compaction.** Wilkins, M.L. (Lawrence Livermore National Lab., CA (USA)). 22 Dec 1983. Contract W-7405-ENG-48. 8p. (CONF-840653—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006133.

From 8. international conference on high energy rate fabrication; San Antonio, TX, USA (17 Jun 1984).

This paper discusses the advantages of powder consolidation by dynamic compaction. With this technique, materials can be fabricated that cannot be made by any other means. Computer simulations are shown to be an effective method to guide an experimental program for optimizing the process. Examples are shown for the consolidation of powders of a metallic glass and the ceramic aluminum nitride.

26909 **(UCRL—90376) High performance, extrusion cast explosive.** Scribner, K.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 24p. (CONF-8406103—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008244.

From Technology of propellants and high explosives annual conference; Fraunhofer, F.R. Germany (27 Jun 1984).

The Lawrence Livermore National Laboratory has been developing a new high energy explosive system for use in precision, high performance munitions. It is a system because the composition and the manufacturing techniques are both unique. The explosive has an energy/density greater than 78% Octol. It is similar to modern type cast/cure explosives except that we can work with higher apparent viscosities since we use low pressure hydraulic systems for deaeration and casting of the explosive. We load any desired device configuration. The crystalline HMX has a nominal 60 μ particle size which contributes to an extremely smooth detonation front. This explosive is suitable for use in the most critical applications such as shaped charges and self forging fragment systems.

26910 **Utilization of accelerating rate calorimetry for the characterization of energetic materials at MRC-Mound.** Pickard, J.M. (Monsanto Research Corp., Miamisburg, OH). *Journal of Hazardous Materials;* 7: 291-302(1983). Contract AC04-76DP00053.

The technique of Accelerating Rate Calorimetry (ARC) was used to investigate the thermal stabilities of energetic materials used in production and manufacturing at MRC-Mound. Plots of heat rate versus temperature, along with temperature and pressure versus time plots, were determined for selected secondary explosives and one model compound. Analyses of these data were used to derive zero-order kinetic parameters, time-to-explosion plots, and approximate critical explosion temperatures.

4502 Nuclear

26911 **(LA-UR—84-1395) Fiber optic sensor applications in field testing.** Perea, J.A. (Los Alamos National Lab., NM (USA)). 11 Apr 1984. Contract W-7405-ENG-36. 23p. (CONF-8404138—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011364.

From 8. national engineering symposium of the Mexican American Engineering Society; Albuquerque, NM, USA (11 Apr 1984).

Fiber optic sensors (F.O.S.) are defined, and the application of this technology to measuring various phenomonon in diverse and hostile environments are discussed. F.O.S. advantages and disavantages both technically and operationally are summarized. Three sensor techniques - intensity, interferometric, and polarization - are then discussed in some detail. General environmental instrumentation and controls that support the Nuclear Weapons Test Program at the Nevada Test Site are discussed next to provide the reader with a basic understanding of the programmatic task. This will aid in recognizing the various difficulties of the traditional measurement techniques at the NTS and the potential advantages that fiber optic measurement systems can provide. An F.O.S. development program is then outlined, depicting a plan to design and fabricate a prototype sensor to be available for field testing by the end of FY84. We conclude with future plans for further development of F.O.S. to measure more of the desired physical parameters for the Test Program, and to eventually become an integral part of an overall measurement and control system.

26912 **(ORNL—6033) Nuclear electromagnetic pulse (EMP) and electric power systems.** Barnes, P.R.; Vance, E.F.; Askins, H.W. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 68p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010665.

A nuclear detonation at high altitudes produces a transient electromagnetic pulse (EMP) of high-intensity electromagnetic fields. A single high-altitude burst can subject most of the continental United States to a strong EMP. These intense fields induce voltage and current transients in electrical conductors. Surges would be induced by EMP in transmission and distribution circuits and in control and communication elements in electric power systems throughout the national grid. Such widespread disturbances could upset the stability of electrical energy systems and result in massive power failures. The extent and nature of EMP-caused damages are not well known for utility electric power systems. Failures are likely to be associated with insulation damage and failures of low-voltage and solid-state components. It is concluded from a review of past studies that EMP may pose a serious threat to the nation's electrical energy supply.

4503 Explosion Detection

26913 **Fast imaging applications in the nuclear test program.** Lear, R. (Lawrence Livermore Nat'l. Lab., Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 495-503(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Applications of fast imaging employ both streak cameras and fast framing techniques. Image intensifier tubes are gated to provide fast two-dimensional shutters of 2-3 ns duration with shatter ratios of greater than 10^6 and resolution greater than 10^4 pixels. Shutters of less than 1 ns have been achieved with experimental tubes. Characterization data demonstrate the importance of tube and pulser design. Streak cameras are used to simultaneously record temporal and intensity information from up to 200 spatial points. Streak cameras are combined with remote readout for downhole uses and are coupled to fiber optic cables for uphole uses. Optical wavelength multiplexing is being studied as a means of compressing additional image data onto optical fibers. Performance data demonstrate tradeoffs between image resolution and system sensitivity.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 26247

26914 (CONF-811048—Summs., pp 4p, Paper 78) **Models for human exposure to air pollution.** Duan, N. (Rand Corp., Santa Monica, CA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Three models for human exposure to air pollution, namely, the Fugas model, integrated personal monitoring and continuous personal monitoring are discussed and compared. (DT)

26915 (CONF-811048—Summs., pp 4p, Paper 81) **Aspects of efficient ventilation in office rooms.** Malmstroem, T.G.; Ahlgren, A. (Royal Inst. of Tech., Stockholm, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In industry in Scandinavia it is rather common to use stratification when designing ventilation systems. Our results indicate that for small offices a ventilation scheme using the natural tendencies for stagnation may be favourable. The supply air must then be brought directly into the working zone without causing excessive mixing and draught problems. If the building is designed for low cooling loads, the tests described indicate that this is possible for Swedish needs and standards. (DT)

26916 (CONF-811048—Summs., pp 5p, Paper 82) **Ventilation efficiency.** Skaret, E.; Mathisen, H.M. (Norwegian Inst. of Tech., Trondheim). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Expressions for ventilation efficiency are derived using a two-box theoretic model. The definition of ventilation efficiency arrived at in this manner can be used for practical measurements, and seems to be valid also for multi-box schemes. Diagonal ventilation schemes are hitherto proved to be the most efficient, and more efficient than having complete mixing. Diagonal schemes are defined to have air exhaust from the circulation box which are located in the remote end with respect to the supply box. (DT)

26917 (CONF-811048—Summs., pp 4p, Paper 83) **Control of indoor air pollution by hypernegionization (HNI) and passive electret filtration.** Wallach, C. (Behavorial Research Associates, Silver Spring, MD). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The two electrical properties of the atmosphere, which can be measured and controlled, are the positive-to-negative ion ratio and the total volumetric small-ion concentration in life-support airspace. Both of these are critical elements in the control of indoor air pollution under conditions where: the rate of generation of inimical pollutants is high, and massive air-exchange rates and high-cost filtration systems are not feasible. The technology for control of charged particles in air is relatively new, and expertise in systems design and engineering very limited; however, from results obtained in a wide spectrum of recent applications, it is confidently predicted that atmospheric ionization and microelectrostatic filtration techniques will quickly become a new wave of methodology within the larger discipline of air treatment and conditioning. (DT)

26918 (CONF-811048—Summs., pp 4p, Paper 84) **Effect of air control systems on the indoor distribution of viable particulates.** Sterling, D.A.; Clark, C.; Bjornson, S. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The physical characteristics of buildings interacting with the properties of particulates enable a natural filtering and sizing process to take place which usually seems to select for the smaller and more easily dispersed particulates to be found indoors. There was evidence of growth of viable particulates within the mechanical air systems which, in conjunction with increased relative humidity may have led to some of the increase of larger particulates found indoors at the central air systems. Air control systems may not be adequate for the control of viable particulate contamination of the indoor environment without modifications and proper maintenance. (DT)

26919 (CONF-811048—Summs., pp 6p, Paper 87) **Indoor air pollution simulations using dynamic multi-compartment models.** Oezkaynak, H.; Ryan, P.B.; Turner, W.A.; Allen, G.A. (Harvard Univ., Cambridge, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Conventional compartmental models developed for indoor environments that utilize solutions to pollutant mass balance equations often fail to account for the temporal and spatial variations in mixing coefficients, or in pollutant transfer/transport, conversion and removal rates. The key limitation of these predictive models, however, is especially recognized under conditions when peak exposure or sharp pollutant concentration gradients are expected. In this paper, alternative modeling options based on dynamic compartmental systems designed to simulate both the short and the long term reactive indoor pollutant concentration profiles are presented. Simulations and assessment of modeling requirements discussed here are related to results of recent measurements made in a house in Newton, MA. (DT).

26920 (CONF-811048—Summs., pp 3p, Paper 88) **Indoor air pollution due to organic gases and vapours of solvents in building materials.** Molhave, L. (Aarhus Univ., Denmark). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A mathematical model was developed for the relation between air concentrations of organic gases and vapours in the indoor environment and the emission of the same compounds from building materials. The model was used to calculate the concentrations of organic gases and vapours to be expected in three hypothetical test rooms constructed with materials with known emissions of these compounds. Taking differences in ventilation, temperature and use of materials into account an acceptable agreement between model prediction and field measurements is therefore indicated. (DT)

26921 (CONF-811048—Summs., pp 6p, Paper 92) **Source emissions and predictive modeling of indoor air pollution.** Scheff, P.A.; Wadden, R.A. (Univ. of Illinois, Chicago). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Several approaches have been used to estimate expected indoor pollutant concentrations. These include deterministic models based on a pollutant mass balance around a particular indoor volume (or an activity balance for radioactive materials); a variety of stochastic approaches based on statistical evaluation of test data and usually least squares regression analysis; and a combination of both forms, empirically fitting the parameters of the mass balance with values statistically derived from experimental measurements. Each approach has advantages. The mass balance model provides more generality in application. But empirical models, for application within the range of measurements from which they were developed, may provide much more accurate information. (DT)

26922 (CONF-811048—Summs., pp 5p, Paper 93) **Dynamic modeling of indoor air quality using high resolution measurements.** Ahuja, D.; Kline, R.V.; Turner, W. (Harvard School of Public Health, Boston, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In order to evaluate the effects of peak exposures, and to relate the concentrations of indoor air pollutants to sources within and outside the structure, it becomes imperative to make finely grained measurements of pollutants of concern. This paper describes some of the results of such measurements made in a house in Newton, Massachusetts, during April and May of 1981. The specific objectives of the study were to evaluate the suitability of using extant carbon monoxide to measure air exchange rates, to estimate the indoor source strength and loss rates of oxides of nitrogen, and to investigate the accuracy of a one compartment model using a mass-balance equation to predict indoor air pollution levels. (DT)

26923 (CONF-811048—Summs., pp 6p, Page 94) **Technique of urban mapping of potential indoor air pollution intensity for public health management.** Kim, M.K.; Schodek, D.L. (Harvard Univ., Cambridge, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The goal of the study was to arrive at the development of a method for producing maps instrumental for the identification of potentially hazard prone urban sectors. The design of the method is specifically aimed at the production of maps which show the distribution of the desired rate of ventilation/air cleaning in an urban area of interest, the distribution of the probable rate of actual ventilation/air-cleaning in the urban area, and a Diagnostic Map showing the discrepancy between the way it should be and the way it is. (DT)

26924 (CONF-811048—Summs., pp 3p, Paper 96) **Case for entirely removing the gas range from indoors.** Sterling, T. (Simon Fraser Univ., Burnaby, British Columbia); Weinkam, J.; Sterling, E. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We examined various socioeconomic models balancing costs and gains for the case of not using natural gas for cooking. In this model, costs are mainly of loss of energy during conversion and of initial investment, while gains are reduced costs for heating homes, for lessened needs to design, install and maintain very effective heat exchangers, cleaner urban air, and possibly decreased health costs. The computer model permits investigation of various options (including the addition of variables) and of costs factors. (DT)

26925 (DOE/EV/10081—T1) **Atmospheric transport and dispersion of pollutants and related meteorological studies. Progress report, FY 1982.** Draxler, R.R.; Ferber, G.J.; Heffter, J.L.; Cordella, R.H. Jr.; Miller, J.M. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Air Resources Labs.). Sep 1982. Contract AI01-76EV10081. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010867.

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Research emphasizes model simulation and experimental verification of the transport and dispersion of atmospheric pollutants. Field experiments of mechanisms affecting long-range transport which provide dispersion data for verification of regional and continental models are stressed. A multi-layer trajectory-dispersion model that incorporates the effects of wind shear was tested against long-range concentration data. Models for prognostic trajectory calculations, using wind fields, have been recoded to permit operational procedures on interactive terminals; and will be used in tracer experiments and emergencies. A new tracer system, using perfluorocarbons, has been developed to provide for long-range dispersion experiments and model validation studies. The tracer system was used in the DOE-ASCOT studies of nocturnal drainage flows in the Geysers geothermal development area. A long-range dispersion study, the Cross-Appalachian Tracer Experiments (CAPTEX) is planned. There will be a series of perfluorocarbon tracer releases in the Ohio Valley with tracer concentration measurements from Ohio to the East Coast. A trial run is planned for September 1982 and a full-scale program in the summer of 1983. A high voluem version of the automatic sequential sampler and an inexpensive adsorption tube sampler were developed. Another tracer experiment is being carried out in collaboration with the DOE Savnnah River Laboratory to provide long-term, regional-scale transport and diffusion data for air pollution model verification. Krypton-85, is sampled at five stations from 300 to 1000 km to the northeast. This one-year twice daily sampling program may be extended to 18 months.

26926 (EUR—8423) **Critical confrontation of standard and more sophisticated methods for modelling the dispersion in air of heavy gas clouds; evaluation and illustration of the intrinsic limitations of both categories.** Riethmuller, M.L. (Commission of the European Communities, Luxembourg). 1983. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700927.

Mathematical models of gas dispersion have evolved drastically since the 1930's. For a long time, the most widely used approach was the so-called Gaussian model as described in practical terms by Turner or box models which have shown relative merits. In the field of heavy gas dispersion, the use of such approaches appeared somewhat limited and therefore new models have been proposed. Some of these new generation models were making use of the latest progress in turbulence modelling as derived from laboratory work as well as numerical advances. The advent of faster and larger computers made possible the development of three dimensional codes that were computing both flow field and gas dispersion taking into account details of the ground obstacles, heat exchange and possibly phase changes as well. The description of these new types of models makes them appear as a considerable improvement over the simpler approaches. However, recent comparisons between many of these have led to the conclusion that the scatter between predictions attained with sophisticated models was just as large as with other ones. It seems therefore, that current researchers might have fallen into the trap of confusing mathematical precision with accuracy. It is therefore felt necessary to enlighten this question by an investigation which, rather than comparing individual models, would analyse the key features of both approaches and put in evidence their relative merits and degree of realism when being really applied.

26927 (LA-UR—84-808) **Some physical concepts in complex terrain meteorology derived from the US Department of Energy's ASCOT program.** Clements, W.E. (Los Alamos National Lab., NM (USA)). 24 Mar 1984. Contract W-7405-ENG-36. 44p. (CONF-8403118—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010059.

From International symposium on the Qinghai-Xizang Plateau and mountain meterorology; Beijing, China (20 Mar 1984).

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Since 1978 the United States Department of Energy's Atmospheric Studies in Complex Terrain program has conducted research fundamental to a better understanding of atmospheric transport and diffusion in complex topographies. Expertise in atmospheric physics theory, computer modeling, laboratory modeling, and field experimentation have been integrated into a balanced program. The initial emphases of the research were on nocturnal drainage winds, the effect terrain has on them, and their interactions with external flows. Highlights of some physical concepts of nocturnal drainage winds, derived mainly from the results of the field experiments, are presented. 21 references, 11 figures.

26928 (LBL—13500, pp 4.7-4.10) **Carbon particles in the arctic.** Rosen, H.J.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

To investigate the chemical composition, origins, and climatic impact of the aerosol, a collaborative sampling program was started by LBL and NOAA in October 1979. This program has emphasized the analyses of the carbonaceous aerosol and its optical properties, but it also has the capability to determine other major aerosol components. Preliminary results from this study show that large concentrations of combustion-generated particles are present in the Arctic and that they may have a significant impact on the heat balance over this region.

26929 **(PNL-SA—12119) Modification of plume models to account for dry deposition.** Horst, T.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 22p. (CONF-8403119—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010778.

From OHOLO conference on boundary layer structure; Zichron Ya'acov, Israel (25 Mar 1984).

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The assumptions and predictions of four diffusion-deposition models are compared. Two simple plume depletion models are recommended. One model applies the analytical, constant eddy-diffusivity solution of the advection-diffusion equation with deposition to the general Gaussian plume model with an arbitrary variation of σ/ sub z/ with distance. Predictions of this model compare welll with those of the surface depletion model, an exact treatment of plume depletion, and it is particularly useful for estimating the transport and deposition of settling particles. The second model is a correction to the simple source depletion model that accounts for the change in the vertical concentration profile caused by deposition. This model is not as simple as that based on the constant eddy diffusivity solution, but its predictions near the surface are very close to those of the surface depletion model and it can be applied to any type of plume model. 27 references, 6 figures.

26930 **(UCRL—53526) Natural phenomena hazards modeling project: extreme wind/tornado hazard models for Department of Energy sites.** Coats, D.W. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 74p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011157.

Lawrence Livermore National Laboratory (LLNL) has developed wind hazard models for the Office of Nuclear Safety (ONS), Department of Energy (DOE). The work is part of a three-phase effort aimed at establishing uniform building design criteria for seismic and wind hazards at DOE sites throughout the United States. In Phase 1, LLNL gathered information on the sites and their critical facilities, including nuclear reactors, fuel-reprocessing plants, high-level waste storage and treatment facilities, and special nuclear material facilities. In Phase 2, development of seismic and wind hazard models, was initiated. These hazard models express the annual probability that the site will experience an earthquake or wind speed greater than some specified magnitude. This report summarizes the final wind/tornado hazard models recommended for each site and the methodology used to develop these models. 19 references, 29 figures, 9 tables.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 25226, 25259, 25289, 25342, 25488, 26118, 26121, 26194, 26478, 26481, 26488, 26495, 26826, 26928, 27010, 27030, 27053, 27057, 27193, 27194, 27195, 27196, 27199, 27201, 27215, 27216, 27223, 27224

26931 **(CONF-790634—7) Field methods to assess the impact of air pollutants on crop yields.** Heagle, A.S.; Riordan, A.J.; Heck, W.W. (Department of Agriculture, Raleigh, NC (USA)). 1979. 13p. NTIS, PC A02/MF A01. Order Number DE84900897.

From 72. annual Air Pollution Control Association meeting; Cincinnati, OH, USA (24 Jun 1979).

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The wide range of estimates for annual losses in crops ($135 to 900 million) from pollutants indicates a lack of objective information on the subject. Estimates have been based primarily on the presence of foliar symptoms but little is known of the relationships between foliar symptoms, plant growth stage, and yield loss. For the most part, the previous estimates disregard subtle injury or yield loss in the absence of symptoms. Sound experimental evidence on the yield responses of plants to ambient levels of pollutants is needed before rational decisions on air pollution control strategies can be made. Recent efforts to experimentally quantify the effects of pollutants on plants in the field have centered on the use of protective chemicals, open-air exposures, ambient pollutant gradients, sensitive and resistant cultivars, or field exposure chambers. Each of these methods has advantages and disadvantages which are discussed. We feel that open-top field chambers are presently the best approach to a critical evaluation of the effects of gaseous pollutants on plant yield. The effects of the chambers on the environment are small, yet pollutant concentrations can be adequately controlled through exclusion and addition. Current methodologies used in open-top field chambers and results showing threshold concentrations of ozone for growth and yield effects of several crop species are presented. Estimates of losses for agricultural crops at different seasonal ozone levels are given. 44 references, 4 figures, 4 tables.

26932 (CONF-811048—Summs., pp 5p, Paper 2) **Trace organic components in office space.** Miksch, R.R.; Hollowell, C.D.; Schmidt, H.E. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Occupants of new office buildings are exposed to elevated levels (relative to outdoor air) of a large variety of organic contaminants that are judged incapable of inducing adverse health effects by existing hygiene criteria. However, the criteria may be inadequate given that: (1) additive or synergistic effects are not adequately addressed; (2) the criteria are generally based on acute exposure studies whereas here the exposure is cronic; (3) the population at risk is more diverse including women and elderly workers; (4) annoyance from odorant effects is not considered. Several sources considered here (new building materials, photocopiers, tobacco smoke and building maintenance products) are of roughly equal magnitude with respect to emissions of organic contaminents. (DT)

26933 (CONF-811048—Summs., pp 3p, Paper 3) **Indoor nitrogen dioxide pollution in the Netherlands.** Lebret, E. (Agricultural Univ., Wageningen, Netherlands); Brunekreef, B.; Boleij, S.M. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Indoor NO_2 levels were 2 to 3 times higher in selected dutch households than the outdoor levels of the same period. Higher NO_2 concentrations were found in kitchens as well as in living rooms of houses with a geiser (water heater) without a flue and in houses with gas space heaters. Elevated NO_2 levels in the living room were associated with the absence of doors and rooms between kitchen and living rooms between kitchen and living room and with a higher number of inhabitants. Long use of the shower and the absence of a ventilation-hood were also found to explain statistically higher concentrations in the kitchen. (DT)

26934 (CONF-811048—Summs., pp 5p, Paper 5) **Carbon monoxide and aerosol concentrations in public access buildings.** Moschandreas, D.J. (IIT Research Inst., Chicago); Pelton, D.J.; Cade, D.R. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We attempted to ascertain that a component of total exposure to CO and respirable suspended particulates (RSP) that is associated with a variety of activities in public access buildings. The time a visitor is exposed to indoor pollutants in these buildings, is relatively short. This fact, combined with the data base generated in this survey, leads to a tentative conclusion that public access buildings should not be considered of high priority. Two additional points must be made: (1) individuals working in certain public access buildings are exposed to high concentrations of CO (especially in underground garages) and RSP (especially in lunges/bars). (DT)

26935 (CONF-811048—Summs., pp 4p, Paper 20) **Inexpensive passive formaldehyde monitor for indoor air quality measurements.** Hawthorne, A.R.; Matthews, TG. (Oak Ridge National Lab., TN). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-26.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This paper describes the development of an inexpensive, passive CH_2O sampler as a complement pumped impinger sampling methodology to provide an integrated exposure measurement. The sampling device is a small container with a dimenthylsilicone membrane opening through which the CH_2O permeates. The sampler's pumping is maintained by providing a concentration sink on the collection side of the sampler. The collection medium is usually water, although 13X molecular sieve has also been used. (DT)

26936 (CONF-811048—Summs., pp 4p, Paper 21) **New passive monitor for determining formaldehyde in indoor air.** Geisling, K.L.; Miksch, R.R.; Rappaport, S.R.; Tashima, M.K. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We have developed a passive sampler that collects HCHO under the principle of diffusion and consists of a glass-fiber filter treated with sodium bisulfite ($NaHSO_3$) contained in a glass vial. Formaldehyde diffuses through the vial and reacts with the $NaHSO_3$ to form a stable addition product. The sampling rate of a passive sampler based on diffusion requires no correction for temperature and pressure variations over the typical range of conditions encountered in indoor air quality audits. (DT)

26937 (CONF-811048—Summs., pp 3p, Paper 22) **Formaldehyde release from formaldehyde-resin containing products: effect of conditioning at 100% relative humidity.** Pickrell, J.A.; Griffis, L.C. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, NM). 1981. NTIS, PC A23/MF A01. Contract AI01-79EV10103.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The measured offgassing rate of CH_2O from plywood in a dessicator decreased after several days at ~ 100% relative humidity. The offgassing rate of CH_2O from particleboard appeared to be relatively stable as the sample was conditioned but day-to-day variability was present. The size of a sample of particle board tested in the dessicator had a profound effect on the measured offgassing of CH_2O with the rate being greatest with the smallest sample. (DT)

26938 (CONF-811048—Summs., pp 3p, Paper 23) **Comparison of the chromotropic acid and pararosaniline methods for HCHO determination using various collection techniques.** Eckmann, A.D. (State Lab. of Hygiene, Madison, WI); Dally, K.A.; Hanrahan, L.P.; Anderson, H.A. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

There has been increasing concern over possible adverse health effects due to off-gassing of formaldehyde from building materials containing urea-formaldehyde resin. Pararosaniline and chromotropic acid methods for analyzing formaldehyde were evaluated. These two methods showed excellent agreement for laboratory-prepared specimens, but correlation between the two methods for air-scrubbed specimens was erratic. Thus it is stressed that field testing is an important step when considering a new laboratory method for the analysis of air-scrubbed specimens. The data suggest that the presence of cigarette smoke and carbon monoxide may be related to the degree of correlation between the pararosaniline and chromotropic acid methods of analysis. (DT)

26939 (CONF-811048—Summs., pp 4p, Paper 24) **Follow-up study of indoor air quality in Wisconsin homes.** Dally, K.A. (State Lab. of Hygiene, Madison, WI); Eckmann, A.D.; Hanrahan, L.P.; Anderson, H.A.; Kanarek, M.S. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In 1978 to 1979 the Wisconsin Division of Health evaluated 100 homes where occupants reported irritation symptoms and had a potential source of formaldehyde in their home. Mean home formaldehyde concentrations ranged from none detected to 3.68 ppM. In 1981, 24 homes that were part of the original study group and three homes studied at a later date, were revisited and formaldehyde samples were collected. (DT)

26940 (CONF-811048—Summs., pp 3p, Paper 26) **Comprehensive air pollution measurements in an environmental unit.** Edgar, R.T.; Rea, W.J. (Brookhaven Environmental Unit., Dallas, TX). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The Environmental Unit was specially constructed to decrease air contaminants due to building materials. Walls were made of porcelain, aluminum, and ceramic tile. Floors were made of hard vinyl or ceramic tile, and ceilings were either aluminum, porcelain, or made of gunite, a low outgassing plaster. A series of studies were then undertaken to monitor air pollution levels inside and outside the Brookhaven Environmental Unit where chemically sensitive patients are treated. (DT)

26941 (CONF-811048—Summs., pp 2p, Paper 27) **Simultaneous measurement of airborne amines, nitrosating potential and nitrosamines.** Fine, D.F.; Rounbehler, D.P.; Bradley, S.J. (New England Inst. for Life Sciences, Waltham, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Secondary and tertiary amines react with nitrogen oxides over a broad range of conditions to produce N-nitrosamines. The amine body burden can be considerably increased by exposure to exogenous amines such as air pollutants, ingredients in soaps and cosmetics, emissions from tobacco smoke, etc. A proper understanding of the problem, therefore, requires the simultaneous artifact-free measurement of nitrosamines, amines and oxides of nitrogen. The capability to carry out all three determinations on the same sample of air has only recently been developed. (DT)

26942 (CONF-811048—Summs., pp 4p, Paper 28) **Longitudinal study of air contaminants in a newly built preschool.** Berglund, B.; Johansson, I.; Lindvall, T. (Univ. of Stockholm, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In a longitudinal study, we are investigating the air quality in a newly built preschool over a 3-year period. The aim is to identify typical indoor air contaminants, to follow their variation over time, and to study the influence of the ventilation system on the contaminants. Volatile organic compounds in the air were sampled by adsorption, separated by gas chromatography, and identified by mass spectrometry. (DT)

26943 (CONF-811048—Summs., pp 4p, Paper 29) **Investigation of health concerns and environmental measurements in a large office building.** Levine, M.S.; Corn, M.; Billings, C.; Singh, J.; Blake, C.L. (Johns Hopkins Univ., Baltimore, MD). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Employees working in a large office building in Washington, DC reported a variety of health problems over a period of several years which were felt to be related to poor indoor air quality. Previous efforts to identify and correct the possible causes of this poor indoor air quality had met with only limited success. We have attempted to establish the nature and extent of the health effects being reported by use of a survey questionnaire, and to correlate these responses with environmental measurements. (DT)

26944 (CONF-811048—Summs., pp 4p, Paper 30) **Impact of different ventilation and lighting levels on building illness: an experimental study.** Sterling, E. (T.D.S. Ltd., Vancouver, British Columbia); Arch, B.; Sterling, T. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We investigated a problem building in Vancouver, British Columbia, in which symptoms of eye irritation, headaches, nausea, and drowsiness were documented by monitoring health and comfort complaints over an extended period of time. The results gained suggests that eye irritability in these offices is probably due to the build-up of photochemical byproducts and that this buildup is accelerated when light contains ultraviolet emissions. (DT)

26945 (CONF-811048—Summs., pp 4p, Paper 34) **Formaldehyde in indoor air: sources and toxicity.** Gupta, K.C.; Ulsamer, A.G.; Preuss, P.W. (Consumer Product Safety Commission, Bethesda, MD). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The Consumer Product Safety Commission has received over 3000 complaints to date involving consumer exposure to formaldehyde vapor released from building materials. Of these, about 2000 involve urea-formaldehyde foam insulation; most of the remainder involve plywood, panelling and other wood products in mobile homes; and a few due to other sources of formaldehyde. (DT)

26946 (CONF-811048—Summs., pp 6p, Paper 41) **Effect of cigarette smoking on residential NO_2 levels.** Good, B.W.; Vilcins, G.; Harvey, W.R.; Clabo, D.A. Jr.; Lewis, A.L. (Philip Morris, Inc., Richmond, VA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The increased level of NO_2 due to cigarette smoking is barely measurable over a seven-day period. Furthermore, while the NO_2 increment measured here for participants without gas appliances is 4 and 3 $\mu g/m^3$ in the summer and winter, respectively, the absolute levels are well below both the NAAQS of 100 $\mu g/m^3$ for annual exposure and the adjacent outdoor level. Also the contribution to the indoor NO_2 level due to gas kitchen appliances completely overpowers that due to the contribution from cigarette smoking. (DT)

26947 (CONF-811048—Summs., pp 3p, Paper 42) **Characterization of aerosols and inorganic gases in indoor environments.** Colome, S.D. (Univ. of California, Irvine); Spengler, J.D.; McCarthy, S. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The sources of indoor aerosols are plentiful. In this report we analyze for two cities a set of elements contained on particles that help to differentiate portions of the aerosol. One city (Steubenville, Ohio) is an industrial city in a river valley and the other (Portage, Wisconsin) is a rural farming community. (DT)

26948 (CONF-811048—Summs., pp 4p, Paper 43) **Spatial variation of carbon monoxide and oxides of nitrogen concentrations inside residences.** Moschandreas, D.J. (IIT Research Inst., Chicago); Zabransky, J. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Pollutants with strong indoor generation are observed to have interzonal statistical differences in gas cooking residences and offices, but not in electric cooking residences. In general, the observed differences in the magnitude of the pollutant concentrations are not large. While more than one zone would be preferable, hourly pollutant concentrations obtained from one indoor zone adequately characterize the indoor environment. (DT)

26949 (CONF-811048—Summs., pp 4p, Paper 44) **Pollutant emissions rates from indoor combustion appliances and sidestream cigarette smoke.** Girman, J.R.; Apte, M.G.; Traynor, G.W.; Hollowell, C.D. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Gas-fired stoves and unvented space heaters (both kerosene- and natural gas-fired types) emit such potentially harmful pollutants as carbon monoxide (CO), carbon dioxide (CO_2), nitric oxide (NO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), formaldehyde (HCHO) and respirable particulates; sidestream tobacco smoking emits CO, CO_2, NO, NO_2, respirable particulates and a wide range of organic compounds. The degree of the indoor air pollution depends on the type and amount of pollutants entering the occupied space and the type and rate of removal processes occurring. In this paper, we report the pollutant emission rates derived from our studies of a gas-fired stove, gas-fired unvented space heater, kerosene-fired unvented space heater and sidestream cigarette smoke. (DT)

26950 (CONF-811048—Summs., pp 3p, Paper 46) **Indoor carbon monoxide pollution in the Netherlands.** Brunekreef, B. (Agricultural Univ., Wageningen, Netherlands); Lebret, E.; Boleij, J.S.M.; Biersteker, K. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Elevated CO levels in indoor air in kitchens equipped with geisers in the Netherlands are associated with burner type, presence of a flue and maintenance system. 27% of the geisers had a CO concentration in the flue gases above the level required by the local gas companies. Levels in excess of existing standards (50 ppM), occurred in 17% of the kitchens. (DT)

26951 (CONF-811048—Summs., pp 5p, Paper 47) **Aluminum, iron, and lead concentrations of personal, indoor, and outdoor respirable particles.** Tosteson, T.D.; Spengler, J.D.; Weker, R.A. (Harvard Univ. School of Public Health, Boston, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This paper describes the indoor, outdoor, and personal concentrations for lead, iron, and aluminum experienced by 18 non-smoking individuals in Topeka, Kansas. The samples chosen for elemental analysis by atomic absorption (AA) spectroscopy are samples collected by volunteers during May and June of 1979. (DT)

26952 (CONF-811048—Summs., pp 4p, Paper 48) **Multipollutant sampler for indoor and outdoor ambient air.** Pengelly, L.D.; Kerigan, A.T.; Goldsmith, C.H.; Furlong, W.; Spurgeon, W.; Toplack, S. (McMaster Univ., Hamilton, Ontario). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The Gage Research Institute has developed, built and operated multi-pollutant personal samplers. We have modified these designs to produce a stationary instrument capable of 24-hour indoor and outdoor automatic sampling. The instrument was specifically designed to address our present survey requirements. However, with minor modifications, the design can be adapted to meet a wide variety of sampling needs. (DT)

26953 (CONF-811048—Summs., pp 4p, Paper 49) **Respiratory effects of household exposures to tobacco smoke and gas cooking on non-smokers.** Helsing, K.J.; Comstock, G.W.; Meyer, M.B.; Tockman, M.S. (Johns Hopkins Univ., Baltimore, MD). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Only recently have the effects of smoke from open fires in huts been documented as a cause of chronic respiratory diseases. There are disagreements between studies on the respiratory effects associated with gas cooking. Some studies have reported deleterious effects while others failed to find any. The present study was undertaken because of the unique opportunity that was presented to utilize data on hand from two studies conducted for other purposes and from a health census which provided additional household information. Our findings, if substantiated by other studies, emphasize the importance of providing for ventilating hoods over gas stoves, especially when a house is well constructed or retrofitted to reduce infiltrtaion. An effect of passive smoking could not be demonstrated with the number of subjects in this study. (DT)

26954 (CONF-811048—Summs., pp 4p, Paper 50) **Pulmonary functions of children and indoor NO_2 concentrations in Portage, Wisconsin.** Letz, R.; Ware, J.H.; Ferris, B.G. Jr.; Spengler, J.D. (Harvard School of Public Health, Boston, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We began this study with the assumption that the decreases in lung function and increases in respiratory illness found in large epidemiological studies for children living in gas-cooking homes were likely to be due to increased NO_2 exposure. We hoped that the gains from better quantifying exposure by directly measuring NO_2 levels in the homes would more than offset the losses from working with a smaller sample size. This was not the case. Several explanations are possible. NO_2 is not the offending agent. Gas stoves emit carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxide, formaldehyde, hydrogen cyanide, water vapor, carbon and sulfate particles. In addition, different stoves and fuels may produce different mixes of these products. Only a sensitive sub-population is affected by the offending agents(s), and they were not represented well in this group. Peak levels of NO_2 cause the health effects and our long-term averages are poorly related to those peaks. Our failure and that of Florey et al. (1979) to relate NO_2 levels to respiratory function were due to chance variation. Perhaps such a relationship exists and can only be detected by a much larger sample size. (DT)

26955 (CONF-811048—Summs., pp 4p, Paper 51) **Effects of ambient urban air pollution on asthmatics.** Silverman, F.; Corey, P.; Mintz, S.; Oliver, P.; Hosein, R. (The Gage Research Inst., Toronto, Ontario). 1981. NTIS, PC A13/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The levels of pollutants measured in this study are very low. Differences in assessment of exposure to air pollution occur between personal, indoor, outdoor and fixed location (Ministry of the Environment) monitoring which confirm the need to use personal exposure measurements in studies of health effects of air pollution. The effects of air pollution on pulmonary function at the low levels that occur in the Toronto area are inconclusive. (DT)

26956 (CONF-811048—Summs., pp 3p, Paper 54) **Chemical dusts, vapours and fumes as causes of asthma.** Pepys, J. 1981. NTIS, PC A13/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Chemical agents causing occupational asthma are also encountered under general environmental conditions. Specific identification of the etiological cause can present problems because the chemical agents may be irritant, toxic or too potently allergenic and unsuitable for clinical testing as with common allergens. The use of simulated occupational type exposures enables precise etiological diagnosis to be made. These tests may be as short as a few breaths or a few minutes, showing that the reactions are probably of an allergic nature. The outstanding characteristic feature of allergy is the minute amounts which can provoke one or more patterns of asthmatic reaction.

26957 (CONF-811048—Summs., pp 6p, Paper 56) **Indoor air quality in new energy-efficient houses and retrofitted houses.** Hollowell, C.D.; Berk, J.V.; Brown, S.R.; Dillworth, J.; Koonce, J.F.; Young, R.A. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Our studies of new energy-efficient residences (with air-exchange rates lower than 0.4 ach) indicate that indoor levels of radon, formaldehyde, and particulates sometimes exceed existing guidelines or standards for outdoor air, due to a number of factors, such as geographic variation of radon content in soil, indoor furnishings, and occupant activities. The impact of residential retrofit programs on indoor air quality appears to be minimal, based on this study of three retrofitted houses where no pollutants reached levels approaching health guidelines or standards. We can conclude that retrofit programs such as that of Pacific Power and Light Company improve the thermal integrity of houses and should continue without fear of significantly increasing indoor air pollution. In the Cranbury house, the super retrofit had no appreciable effect on the infiltration rate already achieved by the homeowner's prior weatherization and thus little or no adverse impact on indoor air quality resulted from this super retrofit. (DT)

26958 (CONF-811048—Summs., pp 3p, Paper 62) **Indoor climate in low-ventilated day-care institutions.** Lundqvist, G.R.; Iversen, M.; Korsgaard, J. (Univ. of Aarhus, Denmark). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The air quality in two new day-care institutions fulfilling the requirements for energy savings, as made in the Danish building codes for housing, was found to be inadmissibly poor due to the low natural infiltration rate and to the degree of occupancy of the squad rooms. No special guidelines for air supply rates for children are given in the recommendations for ventilation requirements. This seems to be a problem to be solved for a more elaborate engineering design of the cimate of such indoor environments, a design which should fulfill hygienic Threshold Values as well as demands for energy savings. (DT)

26959 (CONF-811048—Summs., pp 5p, Paper 63) **Low-infiltration housing in Rochester, New York: a study of air-exchange rates and indoor air quality.** Offermann, F.J. (Lawrence Berkeley Lab., CA); Hollowell, C.D.; Roseme, G.D.; Rizzuto, J.E. 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The results of measurements of leakage area, air-exchange rate, and concentrations of Rn, NO_2, HCHO, and RH in the ten houses selected for a detailed study of indoor air quality are summarized. In the full sample of 60 houses, the specific leakage area varied from 1.3 to 9.0 cm/m^2. Of the 49 houses built by one of the builders, the 36 houses with special weatherization components, (e.g., polyethylene vapor barriers in the outside walls and sealing of all joints and electric outlets) had an average specific leakage area of 2.8 cm^2/m^2 which is 35% lower than the 4.3 cm^2/m^2 average measured in 13 similar houses without such components. The indoor concentrations of Rn, NO_2, HCHO, and RCHO measured during both ventilated and unventilated periods were below the various guidelines presently used to assess indoor air quality. (DT)

26960 (CONF-811048—Summs., pp 5p, Paper 71) **Personal exposure to carbon monoxide: nine person study data analysis and conclusions.** Ziskind, R.A. (Science Applications, Inc., Los Angeles, CA); Fite, K.R.; Mage, D.T. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

For 45 test days, 9 subjects chosen at random from the general population of Los Angeles county carried personal carbon monoxide samplers coupled to electronic output integrators and recorded their daily activities. The group included one bus commuter, one bicycle commuter, and two smokers. Their daily activities covered a wide geographical area. Exposure activity profiles were examined using data from the same subject on different days (autocorrelation) and among different subjects on the same day (cross correlation) in order to assist in formulating a sampling design for a large scale study. (DT)

26961 (CONF-811048—Summs., pp 4p, Paper 72) **Measurement of carbon monoxide concentrations in indoor and outdoor locations using personal exposure monitors.** Ott, W.; Flachsbart, P. (Environmental Protection Agency, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

It appears that most commercial settings have indoor CO concentrations above zero due to seepage of CO into buildings from vehicular emissions. However, levels are not often above 5 ppM and seldom are higher than health-related ambient air quality standards. In buildings that have underground garages, in the ga-

rages themselves, and in some structures with unusually heavy traffic outside carbon monoxide levels can violate existing ambient air quality standards indoors. (DT)

26962 (CONF-811048—Summs., pp 4p, Paper 73) **Study on the personal exposure dose to nitrogen dioxide.** Maeda, K.; Nitta, H. (Univ. of Tokyo, Hongo Tokyo, Japan). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We have studied personal exposure dose to NO_2 for housewives and office workers in Tokyo using small passive NO_2 sampler, and observed things which relate to the extent of exposure dose to NO_2. (DT)

26963 (CONF-811048—Summs., pp 5p, Paper 74) **Personal monitoring for nitrogen dioxide exposure: methodological considerations for a community study.** Quackenboss, J.J. (Univ. of Wisconsin, Madison); Kanarek, M.S.; Spengler, J.D.; Letz, R. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A pilot study to develop and test procedures and materials for determining average personal exposure to NO_2 for a general population group was undertaken in conjunction with the ongoing Harvard Six City air pollution health study. Small and easy to use passive diffusion monitors were used to give integrated averages of exposure during the total sampling period. (DT)

26964 (CONF-811048—Summs., pp 3p, Paper 75) **Individual human exposure to volatile organic compounds encountered during normal daily activities.** Wallace, L. (Environmental Protection Agency, Washington, DC); Pellizzari, E. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Monitoring individual exposures and body-burdens for a number of volatile organic compounds simultaneously are feasible and gives useful information even at normal ambient concentrations. The 10 compounds were detected most of the time in air and breath, but not in blood or drinking water. Wide ranges in air exposures were encountered, even among residents of a single small urban area.

26965 (CONF-811048—Summs., pp 6p, Paper 76) **Personal exposures to respirable particulates; a tale of two cities - Kingston and Harriman, Tennessee.** Spengler, J.D.; Treitman, R.D.; Tosteson, T.D.; Mage, D.T. (Harvard Univ. School of Public Health, Boston, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This personal monitoring study was designed to test the feasibility of directly measuring the respirable particulate matter exposure on a subset of people involved in a large air pollution health study. The study was designed to obtain exposure data for several categories of persons during several days in late winter/early spring. The personal, indoor, and outdoor respirable particulate concentrations and the intergroup, between day, and between location relationships are described. (DT)

26966 (CONF-811048—Summs., pp 3p, Paper 77) **Personal exposure versus monitoring station data for respirable particles.** Sega, K.; Fugas, M. (Inst. for Medical Research and Occupational Health, Zagreb, Yugoslavia). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The aim of this investigation was to estimate actual exposure to man of respirable particles and how well it can be assessed from the data on suspended particulate matter (SPM) concentration as measured by a network station nearest to people's homes. Personal exposure measurements included 12 subjects, working at the same place but living in different parts of the city represented by four ambient network stations. Subjects' exposure was monitored for seven consecutive days in the course of four winter months in 1980/81. (DT)

26967 (CONF-811048—Summs., pp 4p, Paper 79) **Design of a personal sampler of three respiratory irritants.** Mintz, S.; Hosein, R.; Batten, B.; Silverman, F. (The Gage Research Inst., Toronto, Ontario). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We have designed a light, portable, quiet ambient three-pollutant sampler which can be used for assessment of personal exposure to air pollutants. Our sampler appears to be sensitive for SO_2, NO_2 and could be used for other gases. (DT)

26968 (CONF-811048—Summs., pp 3p, Paper 80) **Development and characterization of personal samplers for particulates and gases.** McKenzie, R.L.; Bright, D.S.; Cadoff, B.C.; Fletcher, R.A.; Hodgeson, J.A. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We have developed new personal samplers for NO_2 and for respirable and inhalable particulates that are capable of high sampling rates, making it feasible to measure these pollutants at very low ambient levels or at average ambient levels for shorter sampling periods than has been possible with earlier devices. (DT)

26969 (CONF-811048—Summs., pp 4p, Paper 86) **Control of the ventilation by CO_2 content.** Soedergren, D.; Petersson, P. (Konstruktionsbyra, Stockholm, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

During this study on outdoor air control system based on the constant CO_2-concentration in the indoor air has been operated successfully. Determining a suitable set point for the CO_2-concentration needs, however more experimental work. (DT)

26970 (CONF-811048—Summs., pp 3p, Paper 89) **Investigation of the offgassing decay function in aging mobile homes with climate corrected formaldehyde readings.** Hanrahan, L.P. (Wisconsin Div. of Health, Madison); Anderson, H.A.; Dailly, K.A.; Eckmann, A.D.; Kanarek, M.S. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The repeated measurement of mobile homes for formaldehyde failed to exhibit a systematic correlation between the sequential readings taken in each home. The log of the home age in months was seen to be the single best predictor of both climate corrected and uncorrected formaldehyde readings. These findings are in accord with unpublished analyses previously performed by the Wisconsin Division of Health. An improvement in these models' predictive power is suggested by the inclusion of variables that begin to quantify ventilation rates found in the home at the time of sampling. (DT)

26971 (CONF-811048—Summs., pp 4p, Paper 98) **Indoor air-pollution: some Canadian experiences.** Ferahian, R.H. (Consulting Engineer, Westmount, Quebec). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The recent emphasis on energy conservation measures in buildings have created concern regarding their effect on the indoor air quality. There has been much research done on indoor air pollution and its health effects. But it is only very recently that it has begun to attract the attention it deserves in Canadian Governmental and Building Code Circles. Our laws must ensure good air quality in our living and working habitat as an environmental human right not only as it is introduced into the building but as it reaches the persons inside. All the research and findings about good air quality will be of no use to the average citizen if it is not applied and translated into rules incorporated in the building codes for design, construction, and - last but certainly not least - maintenance of our buildings. And scientifically-based, uptodate building codes are not

much use if they are not complemented by strict honest and competent building inspectors. (DT)

26972 (CONF-811048—Summs., pp 8p, Paper 99) **Strategy for reduction of toxic indoor emissions.** Andersen, I.; Seedorff, L.; Skov, A. (Danish National Inst. of Occupational Health, Hellerup, Denmark). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A strategy for the reduction of toxic emissions from building materials is put forward where the effort is concentrated on three groups of indoor air pollutants: carciongens, irritants and odors. The experiences from the National Danish Inventory of Toxic Substances and Products are that a notification system makes it possible effectively to survey building materials and products and their areas of application. Based on this knowledge it is possible to determine where a need for regulations or investigations exists. Knowledge about the composition of building materials in the epoxy/polyurethane group has made it possible to select the products and materials with the least impact on human health and comfort and with the lowest need for supply of ventilating air. Producers of building materials are invited to make themselves acquainted with these principles of prevention and to utilize them for improvement of the quality of their products and consequently for an improvement of the quality of indoor air. (DT)

26973 (CONF-840612—5) **Clean air targets and the politics of urban travel: a case study.** Saricks, C.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 18p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010728.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

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This study has among other findings substantiated the observation that, under the relaxed mobile-source NO/sub x/ standards of H.R. 5252, rapid vehicle motor travel (VMT) growth would produce a net increase in NO/sub x/ loading from mobile sources at least through the remaining years of the present decade. However, moderate VMT growth will result in stable or slightly declining mobile-source NO/sub x/. Consequently, any urbanized area that is currently in attainment with respect to ambient NO/sub x/ and expects neither high VMT growth (≧ 5% per year) nor a radical change in the distribution of its highway fleet mix (car/truck split) is probably safe from future NO/sub x/ attainment problems. If such problems are forecast, the relevant planning and air quality control agencies should probably reexamine the premises on which their regional travel projections are based. On the other hand, metropolitan areas that will experience high VMT growth must realize that this growth is associated with rapid residential development, a major factor in increasing area source NO/sub x/ burden. Even if such areas are not now subject to NO/sub x/ levels at or near the ambient standard, reevaluation of NO/sub x/ control strategies for a future in which automobile emission standards are relaxed would be appropriate.

26974 (EPRI-EA—3078) **Evaluation of three first-order closure models - Plains Site. Final report.** Reynolds, S.D.; Morris, R.E.; Myers, T.C.; Liu, M.K. (Systems Applications, Inc., San Rafael, CA (USA)). Feb 1984. 601p. Research Reports Center, Box 50490, Palo Alto, CA 94303.

This phase of the EPRI Plume Model Validation and Development (PMV and D) Project involves the evaluation of three first-order closure models using a data base collected over relatively flat terrain in the vicinity of the Kincaid Generating Station in Illinois during 1980 and 1981. The three models examined in this study were the Buoyant Plume Model (BPM), the Atmospheric Diffusion Particle-In-Cell (ADPIC) Model and the Plume Dispersion Model (PDM). In addition, the performance of ADPIC and PDM was compared with that of three Gaussian models using a common data set. BPM predictions of plume height and spread downwind of the stack were evaluated using 86 hours of ground-based lidar observations; predictions tended to be greater than the measurements. Both ADPIC and PDM simulated many of the basic phenomena observed during the field experiments. Model performance was evaluated using 100 hours of ground-level SF_6 observations collected with a movable array of 200 samplers. ADPIC tended to underpredict the highest observation, the set of highest hourly values paired in time, and the set of all values paired in time and location. PDM overpredicted both the highest value and the set of all values paired in time and location, and tended to underpredict the set of highest hourly values paired in time only. Neither model's performance was uniformly better than that of the Gaussian models examined in the operational validation phase of this project. 46 references, 27 figures, 29 tables.

26975 (LA—10025) **Dust particles in high-speed flows: calculations of small-particle re-entry hydrodynamics.** Sandford, M.T. II. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010998.

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Numerical hydrodynamic calculations are used to model the dispersion of dust injected into a supersonic flow by the explosive disruption of a re-entry vehicle. The particles constitute an initial dustball that expands into the existing velocity field after the detonation. Dust grains subsequently form a plume along the vehicle path. The importance of aerodynamic and radiative heating of the dust is considered but not included in the calculations. Particles in the bow shock heat to the vaporization temperature because of drag and radiative heating, but particles in the dustball are shielded and consequently suffer only a small amount of vaporization. About 20% of the initial dust mass will be vaporized. Application of the results to dust grains entrained in the air blast of a near-surface nuclear explosion is briefly considered. 4 references, 6 figures, 1 table.

26976 (LBL—13500, pp 3.12-3.14) **Effects of ventilation on residential air pollution due to emissions from a gas-fired range.** Traynor, G.W.; Apte, M.G.; Dillworth, J.F.; Hollowell, C.D. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

This study investigates the effect of infiltration and two types of mechanical ventilation on indoor CO, CO^2, and NO/sub x/ concentrations from a gas-fired range: spot ventilation and whole-house ventilation. A range hood was used to evaluate spot ventilation; and an extensively ducted ventilation system, with three exhaust sites and five inlet sites which incorporated an air-to-air heat exchanger, was used in these studies are compared to those derived from an indoor air quality model.

26977 (LBL—13500, pp 3.18-3.21) **Organic contaminants.** Miksch, R.R.; Hollowell, C.D.; Schmidt, H.E. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Preliminary data suggest that workers in office environments are exposed to a broad spectrum of compounds present at very low levels relative to permissible exposures but high levels relative to outdoor air. Preliminary data on the identities and relative amounts of organic contaminants in representative office spaces are discussed, as well as potential sources in new and aged building materials, wet-process photocopiers, smoking, and building maintenance products are presented.

26978 (LBL—13500, pp 3.21-3.23) **New passive monitor for determining formaldehyde in indoor air.** Geisling, K.L.; Girman, J.R.; Miksch, R.R.; Rappaport, S.M.; Tashima, M.K. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The sampler reported here is lightweight and small, can be operated by untrained personnel, and is very inexpensive. Once in the field, the passive monitor is merely uncapped, placed in a vertical position, and left for the appropriate sampling period. Following exposure, the sampler is recapped and returned to the laboratory for analysis.

26979 (LBL—13500, pp 3.24-3.26) **Distribution of indoor radon concentrations and source magnitudes: measurements and policy implications.** Nero, A.V. Jr.; Boegel, M.L.; Doyle, S.M.; Moed, B.A.; Nazaroff, W.W. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Indoor radon concentrations varied over a large range and did not correlate well with infiltration rate. Calculation of source magnitudes for the houses monitored yielded values ranging over three orders of magnitude, and this variation appeared to be the main cause of the variation in indoor concentrations. Radon emanation rates from building materials such as concrete do not account for the source magnitudes observed. On the other hand, the radon flux from soil averages ten times as much as that from concrete and could account for the source magnitudes observed. The observed distribution in indoor concentrations suggests that a significant portion of the population is subject to unusually high risks, and variations in source magnitude need to be considered in developing strategies for identifying this portion of the population and for reducing indoor concentrations.

26980 (LBL—13500, pp 3.27-3.29) **Insturmentation for a radon research house.** Nazaroff, W.W.; Nero, A.V. Jr.; Revzan, K.L.; Robb, A.W. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The essential design and function of the instrumentation system as a whole are described, singling out those components that measure ventilation rate, radon concentration, and radon-daughter concentrations.

26981 (LBL—13500, pp 3.34-3.36) **Low-infiltration housing in Rochester, New York: a study of air-exchange rates and indoor air quality.** Offermann, F.J.; Dillworth, J.F.; Grimsrud, D.T.; Hollowell, C.D.; Koonce, J.F. Jr.; Nazaroff, W.W.; Pepper, J.H.; Robb, A.W.; Roseme, G.D.; Young, R.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Results are presented of the leakage area, air-exchange rate, and indoor air quality for ten houses with and without mechanical ventilation systems. Indoor and outdoor temperatures, average daily humidity, concentrations of aldehydes, formaldehyde, nitrogen dioxide, carbon monoxide, carbon dioxide, nitric oxide, ozine, sulfur dioxide and particulates were measured. (PSB)

26982 (LBL—13500, pp 4.2-4.5) **SO_2 oxidation of soot particles exposed to water.** Benner, W.H.; Ljungstrom, E.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

The oxidation of SO_2 in the atmosphere leads to the formation of sulfuric acid, which, if incorporated into cloud and rain water and not neutralized by ammonia, can acidify the water. The oxidation of SO_2 can produce gas-to-particle transformations and can lead to haze formation. In the ambient atmosphere, SO_2 is oxidized by a variety of homogeneous and heterogeneous chemical reactions. The research reported here focuses on several heterogeneous (i.e., gas-droplet/particle) reaction pathways.

26983 (LBL—13500, pp 4.5-4.7) **Aqueous reactions of nitrite with bisulfite ions in sulfate aerosol formation.** Oblath, S.B.; Chang, S.G.; Markowitz, S.S.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Enviornment Division, annual report, FY 1981.

Results are reported for a continuing study of the kinetic reactions of nitrite ion with sulfur dioxide in aqueous solution as a model system for the aerosol droplets. These and other researchers found that under conditions which are likely to be found in a polluted atmosphere, the reactions can be briefly summarized as follows: nitrite and bisulfite ions react to form either nitrous oxide or hydroxylamine disulfonate, depending on the acidity; hydroxylamine disulfonate undergoes hydrolysis to hydroxylamine monosulfonate (HAMS) and sulfate ion. Hydroxylamine monosulfonate reacts with nitrite ion to form nitrous oxide and sulfate ion. Kinetic rate equations are presented. (PSB)

26984 (LBL—13500, pp 4.10-4.13) **Application of thermal analysis and photoelectron spectroscopy for the characterizatoin of particulate matter.** Dod, R.L.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Analytical results are compared using thermal analysis in the evolved-gas-analysis mode to contrast photoelectron spectroscopy methods which may allow some volatile species to escape during analysis of sulfate, ammonium, and nitrate ions and other elements and species. Inconsistency of results was found and research continues. A tentative explanation is given. (PSB)

26985 (LBL—13500, pp 4.13-4.16) **Theoretical studies of the thermal decomposition of carbonaceous aerosol particulates.** Hansen, A.D.A.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

A theoretical approach to the interpretation of evolved gas analysis, which classifies sample components according to their thermal decomposition characteristics, is presented for the graphitic carbon component of aerosol particles. (PSB)

26986 (LBL—13500, pp 4.16-4.19) **Application of selective solvent extraction to carbonaceous aerosols.** Gundel, L.A.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Carbonaceous components of particles from New York City, Los Angeles, and Berkeley are very similar when characterized by the selective solvent extraction-carbon analysis technique. Photochemical activity, as indicated by ozone level, was much less intensive in Berkeley and New York City than in Los Angeles, although fractions of polar and nonpolar carbon are very similar for the two locations. Automotive and diesel primary combustion particles differ from ambient particles by enrichment in amounts of nonpolar carbon; however, significant fractions of polar carbon are also associated with all combustion sources studied here.

26987 (LBL—13500, pp 4.20-4.22) **Relation between concentrations of polynuclear aromatic hydrocarbons and black carbon.** Gundel, L.A.; Rosen, H.J.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Five fluorescent compounds have been identified in the extracts of particulate matter collected at every site: benzo(b)fluoranthene (BbF), benzo(k)fluoranthene (BKF), benzo(a)pyrene (BaP), benzo(ghi)perylene (BghiP), and indeno(1,2,3-cd)pyrene (IcdP). Some PAH compounds which fluoresce weakly under the same conditions were not detected: chrysene, benzo(e)pyrene, dibenz(a,h) anthracene, and perylene. The PAH compounds found in this study have been detected in urban praticulate matter collected in other cities and in particulate samples from combustion sources.

26988 (LBL—13500, pp 4.22-4.23) **Determination of low-Z elements simultaneously by charged particle activation analysis.** McKinney, M.; Markowitz, S.S.; Novakov, T. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The experiments for simultaneous determination of C, N, and O were carried out using the stacked-foil technique, and the samples and standards were irradiated and counted within 2 to 3 minutes at the 88-inch Cyclotron. The 14-MeV ^3He beam was degraded to 10 MeV, and both the aerosol sample, on a silver filter, and the 1/2-mil nylon standard were bombarded at the same energy and

with the same number of microcoulombs. The samples were irradiated for 0.5 minutes at 0.5 μA beam intensity and were analyzed by detecting the 511-keV positron annihilation radiation in coincidence using 3-inch NaI crystals and Ortec single-channel analyzers. The carbon determinations agreed well with combustion analysis, but the nitrogen determinations were substantially higher. This was presumably caused by sulfur and silicon in the aerosol which produced ^{31}P with a 2.5-minute half-life, which interfered with the nitrogen determination. For this reason deuterons were chosen as the particle.

26989 (LBL—13500, pp 4.24-4.36) **Applied physics and laser spectroscopy research.** Amer, N.M.; Cooper, M.S.; Gerlach, R.W.; Hall, R.P.; Jackson, W.B.; Johnson, R.L.; Kohn, S.E.; Kulik, S.J.; Olmstead, M.A.; Skumanich, A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The research pilosophy of this group is to apply the knowledge of advanced laser spectroscopy and condensed-matter physics to energy and environmental problems. Because of the narrow line width and tunability of lasers, unsurpassed sensitivity and specificity can be achieved in detecting trace contaminants of the environment. The advanced state of condensed-matter physics makes it possible to apply such knowledge to energy production and to test novel methods for energy conversion such as photovoltaic solar cells, superionic electrical energy storage devices, and the recovery and extraction of oil from abandoned wells and oil shale with lyotropic liquid-crystal emulsifiers.

26990 (LBL—13500, pp 4.121-4.122) **Development and application of x-ray fluorescence analytical techniques.** Giauque, R.D.; Sindelar, L.E. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

X-ray fluorescence (XRF) techniques are being developed and applied to support programs which require trace multielement chemical analysis. Emphasis is placed on improving the sensitivity capability of XRF and establishing accurate methods which compensate for matrix effects. XRF methods are applied to support: (1) oil shale; (2) atmospheric aerosol; (3) waste management; and (4) geochemical research programs. A primary purpose of these programs is to study the distribution, speciation, and fate of numerous trace elements. An XRF method for the determination of forty elements of atomic number 22 (Ti) and higher, in oil shale and geochemical specimens, has been developed.

26991 (N—8410331) **Research program for effects of acidic deposition on materials and cultural resources.** Spence, J.W.; Haynie, F.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jul 1983. 12p. (PB—83-232074; EPA—600/D-83-087). NTIS, PC A02/MF A01.

The framework of a research program to develop the methodology and data bases for assessing the material related benefits of acidic deposition control policies and guidelines for protecting or restoring individual structures especially historical and cultural sites is given. Seven basic areas of research are identified.

26992 (PB—84-149632) **Characterization of carbon fiber emissions from current and projected activities for the manufacture and disposal of carbon fiber products. Final report.** Gieseke, J.A.; Reif, R.B.; Schmidt, E.W. (Battelle Columbus Labs., OH (USA)). Jan 1984. 59p. NTIS, PC A04/MF A01.

Composite materials formed by impregnating a carbon or graphite fiber mat with plastic binders are being used increasingly in military, aerospace, sports and automotive applications. Carbon fibers are formed primarily from synthetic fibers carbonized in the absence of oxygen. Possibilities exist for the release of these fibers to ambient air during their formation, handling, weaving or impregnation, or during the manufacturing or incineration of composites. This study was concerned with characterizing the rate and physical/chemical properties of such emissions. Samples were collected from manufacturing operations. Operations considered included fiber winding, prepregging and weaving, as well as composity cutting, grinding, drilling, machining, sanding, and incineration. Release rates (fiber mass released per unit of material processed) ranged over several orders of magnitude with the largest releases being associated with weaving and incineration. Except for incineration where fiber diameters were reduced somewhat by burning, the original fiber diameters were maintained in the emitted material. Fiber lengths varied over wide ranges from tens to thousands of micrometers. Incineration experiments suggested that mechanical agitation and air flow in the incinerator would strongly affect releases. Electrical characterization of the fibers demonstrated that fibers will move and form chains in electrical fields.

26993 (PB—264232) **Ozone and hydrocarbon measurements in recent oxidant transport studies.** Lonneman, W.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jan 1977. 14p. (EPA—600/3-77-001a; CONF-7609221—1). NTIS, PC A02/MF A01. Order Number DE84900921.

From International conference on photochemical oxidant pollution and its control; Raleigh, NC, USA (12 Sep 1976).

In recent years, field studies were undertaken to investigate ozone and ozone-precursor transport. In these studies samples were collected and analyzed for hydrocarbon concentration. The analytical results indicate that rural ambient air downwind of urban centers consists largely of diluted urban mix, with loss of the more reactive hydrocarbon components. Hydrocarbon and nitrogen oxides analyses at Wilmington, Ohio, indicate that high ozone concentrations are probably due to transport processes and are not the result of local photochemical formation. 5 references, 9 figures, 3 tables.

26994 (PNL-SA—11531) **Monitoring indoor pollutants in two small office buildings to support a modeling study.** Parker, G.B.; Lee, R.N.; Dennis, G.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 13p. (CONF-8311122—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010900.

From 20. annual meeting of PNWIS-APCA; Seattle, WA, USA (16 Nov 1983).

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A study was undertaken to monitor outdoor and indoor pollutants and to determine air exchange rate in two small office buildings, both constructed in the mid 1970's. Pollutant levels of radon particulate matter, carbon monoxide, oxides of nitrogen, and formaldehyde, were measured over approximately a 3-day period in each office building during the heating season. Measurements of air exchange, temperature, relative humidity and windspeed were also taken. Average workday indoor pollutant levels of formaldehyde, carbon monoxide, oxides of nitrogen and radon were near ambient (outdoor) levels. Indoor concentrations of particulate matter were greater than outdoor levels in both office buildings and significantly greater in the second office building compared to the first. This paper describes the measurement protocol and measurement results. The hourly variation in radon, and particulate matter concentration measured in the second building is also given. 9 references, 2 figures, 3 tables.

26995 **Elemental carbon concentrations: estimation of an historical data base.** Cass, G.R.; Conklin, M.H.; Shah, J.J.; Huntzicker, J.J.; Macias, E.S. (California Inst. of Tech., Pasadena). *Atmospheric Environment;* **18**: No. 1, 153-162(1984). Contract FG03-76ER10058.

While recent advances in instrumentation permit routine determination of elemental carbon concentrations in atmospheric aerosol samples, historical data on elemental C concentrations are absent. Two methods are available for the estimation of an historical data base for elemental C concentrations: calibration of reflectance-based tape samplers and analysis of archived high volume sampler filters. These methods are described and applied to the problem of reconstructing an historical data base for elemental C concentrations in Los Angeles. Twenty-four year average elemental C concentrations at seven monitoring sites in the Los Angeles area are estimated to range from 6.4 $\mu g\ m\sqrt{^{3}}$ at Downtown Los Angeles to 4.5 $\mu g\ m^{-3}$ at West Los Angeles. At most monitoring sites studied, elemental C concentrations were lower in recent years than during the late 1950s and early 1960s.

26996 Cooling tower plume rise analyses by airborne lidar. Uthe, E.E. (SRI International, Menlo Park, CA). *Atmospheric Environment;* **18**: No. 1, 107-119(1984).

As part of the Atmospheric Studies in Complex Terrain (ASCOT) program, five cooling-tower plume experiments were conducted at The Geysers geothermal area in California during August 1981. The experiments were designed to investigate plume behavior during conditions of valley nocturnal drainage flow and daytime vertical mixing on a mountain ridge. The Airborne Lidar Plume and Haze Analyzer (ALPHA-1) system was used during the experiments to observed plume geometry and aerosol structure of the boundary layer. Subvisible plume rise derived from the backscatter signatures is related to visible plume-rise results recently published. This analysis indicates that the lidar-observed plumes are about 10 times higher than visually observed plumes. The lidar-observed plume rise seemed to correspond with heights of elevated aerosol layers that typically indicate presence of temperature inversions. Pictorial displays are presented which provide information on atmospheric behavior mountainous terrain.

26997 Ventilation requirements in buildings. II. Particulate matter and carbon monoxide from cigarette smoking. Leaderer, B.P.; Cain, W.S.; Isseroff, R.; Berglund, L.G. (J.B. Pierce Foundation Lab., New Haven, CT). *Atmospheric Environment;* **18**: No. 1, 99-106(1984).

Current efforts to reduce ventilation rates in buildings may conserve energy, but may also possibly empair human health and welfare through increased levels of indoor contaminants. Combustion of tobacco is one important source of indoor pollution. The authors measured both steady state levels and decays of total suspended particulate mass between 0.01 and 10 μm (TSP) and carbon monoxide (CO) generated during various rates of cigarette smoking and at various rates of ventilation. The measurements took place in an aluminum-lined environmental test chamber. 98% of the particulate mass fell between 0.05 and 1.0 μm, with a volume median diameter of 0.225 μm. For many combinations of smoking rate and ventilation rate, including ventilation rates above normal, TSP exceeded levels considered acceptable outdoors. This rarely occurred, however, with CO. Although ventilation above governed the removal of CO from the chamber, adsorption on surfaces (e.g. ductwork, walls) provided an additional mechanism for the removal of TSP. Even with the additional clearance offered by adsorption, however, particulate levels will exceed commonly accepted background levels unless ventilation during smoking equals the high value of about 35 cfm (17.5 s^{-1}) per occupant. An electrostatic precipitator, on the other hand, will drive TSP levels down to very low values in very short periods of time.

26998 Study on the reaction between CO_2 and alkanolamines in aqueous solution. Blauwhoff, P.M.M.; Versteeg, G.F.; van Swaaij, W.P.M. (Twente Univ. of Tech., Enschede, Netherlands). *Chemical Engineering Science;* **39**: No. 2, 207-225(1984).

Literature data on the rate of reaction between CO_2 and alkanolamines, mono-ethanolamine (MEA), di-ethanolamine (DEA), di-isopropanolamine (DIPA), and methyl-di-ethanolamine (MDEA), in aqueous solution are discussed. These data served as a basis for experiments to study the absorption of CO_2 into aqueous DEA, DIPA, TEA, and MDEA solutions from which the respective rate constants were derived. The experimental technique used for the studies was similar to that used by Laddha and Danckwerts [30]. The results for DEA and DIPA were analyzed by means of a zwitterion-mechanism which was derived from the mechanism originally proposed by Danckwerts [16] and were found to fit the model well. The reaction rate of CO_2 with aqueous TEA and MDEA solutions shows a significant base catalysis effect which is also reported by Donaldson and Nguyen [17] and Barth et al. [4]. The results for TEA corresponded very well with those reported in references 4 and 17.

26999 Comparison of R- and Q-modes in target transformation factor analysis for resolving environmental data. Hwang, S.K.; Severin, K.G.; Hopke, P.K. (Univ. of Illinois, Urbana). *Atmospheric Environment;* **18**: No. 2, 345-352(1984). Contract AC02-80EV10403.

Target transformation factor analysis has been used for the quantitative resolution of environmental data. The initial studies have utilized the correlation between individual samples over the set of measured properties of those samples as the matrix defining the relationships within the data. The analysis of this matrix is a Q-mode analysis. For large data sets, this technique requires the diagonalization of a large matrix. An alternative approach is to examine the matrix of correlations between the measured properties of the samples over all of the individual samples in the data set. The analysis of this matrix is called an R-mode analysis. It is found that for several typical data sets, equivalent results are obtained for the two modes and, in some cases, R-mode may resolve the sources more accurately. 25 references, 3 figures, 8 tables.

27000 Characterization of particles from several sources and three urban areas by solvent extraction. Gundel, L.A.; Novakov, T. (Lawrence Berkeley Lab., CA). *Atmospheric Environment;* **18**: No. 2, 273-276(1984). Contract AC03-76SF00098.

Selective solvent extraction was used to characterize source and ambient particulate matter collected during conditions of low photochemical activity, and the results were compared with those for samples collected during smog episodes. If the technique can correctly distinguish ozone-related, photochemically produced secondary compounds from primary (source) compounds, it should yield very different results for the two sampling conditions. The results of our comparison, however, indicate that selective solvent extraction is unable to uniquely identify the contribution of photochemical processes to the production of ambient particulate matter. 12 references, 2 figures, 1 table.

27001 Mercury emissions from a modified in-situ oil shale retort. Hodgson, A.T.; Pollard, M.J.; Brown, N.J. (Lawrence Berkeley Lab., CA). *Atmospheric Environment;* **18**: No. 2, 247-253(1984). Contract AC03-76SF00098.

Gaseous Hg emissions were measured during the processing of a large modified in-situ oil shale retort (4×10^4 m^3) in Colorado. A continuous, on-line, gas monitor based upon the principal of Zeeman atomic absorption spectroscopy was the primary analytical method. The on-line monitor technique was shown to be well suited for this application and compared favorably with an independent reference method which collects gaseous Hg by Au-amalgamation. Forty-two hours of on-line data were obtained over a 35-day period during the latter half of the retort burn. Hg emission rates in g day^{-1} were calculated from Hg concentration and offgas flow rate data. The predicted total gaseous Hg mass emission for the retort was 4 kg. Extrapolation of the data to a hypothetical modified in-situ oil shale facility with a daily production of 8×10^6 l (5×10^4 bbl) of oil results in a projected emission rate of $\approx$ 8 kg day^{-1}. This estimated value is higher than Hg emission rates recorded for coal fired power plants. Emission rates were found to be highly variable both within and between days. Factors which may limit Hg emissions from a modified in-situ retort are discussed. Adsorption losses to unretorted shale at the bottom of a retort are suggested as a major sink for Hg. Losses of Hg to the extensive offgas plumbing system may also be substantial. 21 references, 4 figures, 2 tables.

27002 Climatic effect of CO_2: a different view. Ellsaesser, H.W. (Lawrence Livermore National Lab., CA). *Atmospheric Environment;* **18**: No. 2, 431-434(1984).

The current eager acceptance of oceanic thermal lag as the explanation as to why CO_2 warming remains undetected, reemphasizes that the atmosphere cannot warm until the oceans do. The logical implication follows that most current climate models are lacking in relevance; they have not been constructed with ocean surface temperature as the fundamental variable. When the problem is attacked from this view, sensitivity to CO_2 is significantly reduced; a position also strongly supported by the available palaeoclimatic data. 30 references.

27003 Rates and mechanisms of cloud water deposition to a subalpine balsam fir forest. Lovett, G.M. (Oak Ridge National Lab., TN). *Atmospheric Environment;* **18**: No. 2, 361-371(1984). Contract W-7405-ENG-26.

A resistance model for deposition of cloud droplets to a balsam fir forest canopy is described. The model accounts for im-

paction and sedimentation of cloud droplets, as well as evaporation and condensation of cloud water on canopy surfaces. It considers multiple height strata in the canopy, seven canopy component types in each stratum, and three size classes of cloud droplets. The model was tested against field data and was found to predict cloud water deposition rates in good agreement with measured values. Analysis of the model shows that in the windy, subalpine zone of New England for which the model was developed, advected cloud water can be deposited at rates on the order of tenths of a millimeter per hour, with deposition velocities ranging from 1 to 80 cm s^{-1}. Most of the cloud water deposition takes place in the top 3 m of the canopy. Inertial impaction is the dominant deposition mechanism, but sedimentation can be important at low wind speeds and in the interior of the canopy. Increases in wind speed cause increased deposition via impaction and decreased deposition via sedimentation. 55 references, 6 figures, 1 table.

27004 **Deposition of sulfuric acid mist in the respiratory tracts of guinea pigs and rats.** Dahl, A.R.; Griffith, W.C. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, NM). *Journal of Toxicology and Environmental Health;* **12**: No. 2-3, 371-383(Aug-Sep 1983). Contract AC04-76EV01013.

Radiolabeled sulfuric acid mists in the size range of 0.4-1.2 μm mass median aerodynamic diameter (MMAD) were generated at 20 and 80% relative humidity at concentrations from 1.3 to 20 μg/l. Guinea pigs and rats were exposed to these aerosols by the nose-only route for short periods (30 s) and were quickly sacrificed and dissected. The regional respiratory-tract deposition patterns were measured. The results indicate that regional deposition fraction is positively correlated with droplet size of the sulfuric acid but is not correlated with atmospheric concentration or relative humidity over the ranges of the parameters studied. A comparison of the data obtained in these studies with those from earlier studies indicates that the deposition of sulfuric acid in the respiratory tract of rats is greater than for nonhygroscopic aerosols having similar MMADS. This may be due to the growth of the droplets in the high humidity of the respiratory tract.

27005 **Detection of chlorine and fluorine in air by laser-induced breakdown spectrometry.** Cremers, D.A.; Radziemski, J. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 8, 1252-1256(Jul 1983).

The use of laser-induced breakdown spectrometry (LIBS) to spectrometrically detect chlorine and fluorine in air directly is investigated. A laser-generated spark is used to atomize chlorine- and fluorine-bearing molecules. The atoms are then electronically excited by the high temperatures of the spark. Emission from the neutral atoms is spectrally and temporally resolved to maximize the signal-to-noise ratio. Optimization of the time window and laser power for minimum detection limits is discussed. The use of LIBS to determine the ratios of the numbers of different types of atoms on a molecule is considered. Minimum detectable concentrations of chlorine and fluorine in air are 8 and 38 ppM (w/w), respectively. Minimum detectable masses of chlorine and fluorine are, respectively, 80 ng and 2000 ng in air and 3 ng for both atoms in He. The precision for replicate sample analysis is 8% RSD. 11 references, 3 figures, 4 tables.

27006 **Photoacoustic spectroscopy in gases based on wavelength modulation.** Yip, B.C.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **55**: No. 6, 978-981(May 1983). Contract W-7405-ENG-82.

In an attempt to reduce background contribution in photoacoustic spectrometry (PAS), wavelength modulation of a commercial CO_2 laser was undertaken. The necessary adaptations and experimental verification of its advantages are reported. The determination of ethylene in nitrogen at atmospheric pressure was used as a test case. In order to evaluate the real advantage using this scheme for PAS measurements, the signal obtained was plotted as a function of concentration of ethylene in nitrogen for the cases of amplitude modulation using the P(14) line of the CO_2 laser and wavelength modulation using the P(12)/P(14) lines. Detection limits of about 15ppB were noted. Since the background seemed to be independent of intensity of the laser, the use of high intensity lasers could be used to extend the useful range of PAS measurements.

27007 **New instrumentation for airborne acid rain research.** Tanner, R.L.; Daum, P.H.; Kelly, T.J. (Brookhaven National Lab., Upton, NY). *International Journal of Environmental Analytical Chemistry;* **13**: 323-335(1983). Contract AC02-76CH00016.

From 12. annual symposium on the analytical chemistry of pollutants; Amsterdam, Netherlands (Apr 1982).

Instrumental methods have been developed for continuously measuring sulfur dioxide, aerosol, sulfur, nitrogen oxides, nitric acid, and ammonia from an aircraft sampling platform. Emphasis has been on modifications to reduce limits of detection to allow sampling at ambient concentrations in the vicinity of cloud water composition and knowledge of the interphase behavior of nitrogen and sulfur oxides and oxyacids, will be used for quantitative evaluation of species contributions to the ionic content of precipitation. A flame photometric instrument with enhanced sensitivity for airborne measurements of both gaseous and aerosol sulfur compounds has been designed and constructed. Ambient airborne levels of less than 1 ppb may be detected using sensitivity enhancement, and effects of pressure changes on instrumental response have been eliminated. Sensitive, real-time measurements of NO/sub x/ and HNO_3 have been achieved by modified commercial ozone-chemiluminescence detectors. These modifications include: (a) operation at low pressure and large throughput; (b) use of an enlarged, more efficient reaction chamber; and (c) use of a pre-reactor to obtain more stable background. The detection limit for a dual channel instrument for aircraft use is <0.2ppb (5 second time constant). Nitric acid is determined continuously by difference using a nylon filter in one stream. An instrument has been constructed for airborne measurements of atmospheric ammonia based on a continuous, fluorescence-derivatization technique. Ammonia is scrubbed into aqueous acid, derivatized and measured in a small filter fluorimeter (HPLC detector). Current detection limit is about 0.25ppb NH_3 with response time of $\sim$ 2.5min. Data acquired from instrument test flights and preliminary characterization flights with this instrument package are discussed.

27008 **Estimation of wet and dry deposition of pollutant sulfur in eastern Canada as a function of major source regions.** Shannon, J.D. (Argonne National Lab., IL); Voldner, E.C. *Water, Air, and Soil Pollution;* **18**: 101-104(1982).

The contributions of major anthropogenic source regions to wet and dry deposition of total S in eastern Canada are estimated for a winter month and a summer month with the ASTRAP model. Results indicate that the US and Canada contribute approximately equal amounts to total S deposition in Canada; Canadian sources contribute more than one half of dry deposition and less than one half of wet deposition.

27009 **Coal gasification.** Hartman, H. *Oak Ridge National Laboratory Review (United States);* **13**: No. 1, 53-57(1980).

Applications, gas preparation, status and prospects of coal gasification technology are reviewed.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 26874, 26957, 26959, 27063, 27064

27010 **(ANL—84-14) Environmental monitoring at Argonne National Laboratory. Annual report for 1983.** Golchert, N.W.; Duffy, T.L.; Sedlet, J. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011530.

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The results of the environmental monitoring program at Argonne National Laboratory for 1983 are presented and discussed. To evaluate the effect of Argonne operations on the environment, measurements were made for a variety of radionuclides in air, surface water, soil, grass, bottom sediment, and milk; for a variety of chemical constituents in air, surface water, ground water, and Argonne effluent water; and of the environmental penetrating radiation dose. Sample collections and measurements were made at the site boundary and off the Argonne site for comparison purposes.

Some on-site measurements were made to aid in the interpretation of the boundary and off-site data. The potential radiation dose to off-site population groups is also estimated. The results of the program are interpreted in terms of the sources and origin of the radioactive and chemical substances (natural, fallout, Argonne, and other) and are compared with applicable environmental quality standards. 19 references, 8 figures, 49 tables.

27011 (CONF-811048—Summs., pp 6p, Paper 7) **Indoor radon levels. Field experience using the track etch method.** Alter, H.W. (Terradex Corp., Walnut Creek, CA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This work demonstrates that the radon concentrations in significant numbers of homes exceed 20 pCi/1 (0.1 WL). This concentration approaches the maximum permitted exposure in uranium mines. Should current attempts to reduce the 4 WLM mine limit to 0.7 WLM be successful, up to 50% of homes monitored in the current work would exceed the mine standard. We note also that present indoor provisional standards in the 0.02 WL (4 pCi/1) range may be considerably below the actual levels in many normal homes. Much additional US indoor radon data is needed to establish firmly the magnitude of a possibly major public health problem. (DT)

27012 (CONF-811048—Summs., pp 5p, Paper 8) **Distribution of indoor radon concentrations and source magnitudes: measurements and policy implications.** Nero, A.V.; Nazaroff, W.W. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Indoor radon concentrations measured by our group vary over a large range and do not correlate with infiltration rate. Calculation of source magnitudes for the houses monitored yields values ranging over three orders of magnitude, and this variation appears to be the main cause of the variation in indoor concentrations. Radon emanation rates from building materials such as concrete do not account for the source magnitudes observed; on the other hand, the radon flux from soil averages ten times as much as that from concrete, and could account for the sourse magnitudes observed. The observed distribution in indoor concentrations suggests that a significant portion of the population is subject to unusually high risks, and variations in source magnitude need to be considered in developing strategies for identifying this portion of the population and for reducing indoor concentrations. (DT)

27013 (CONF-811048—Summs., pp 5p, Paper 9) **Radon concentrations in buildings and regional geology.** Sachs, H.M. (Princeton Univ., NJ); Manlowe, R.; Hernandez, T.L.; Ring, J.W. 1981. NTIS, PC A23/MF A01. Contract AC02-77CS20062.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The radon concentration in a given closed house is a time-varying function of a fairly small number of factors. In order of decreasing expected variability, these are the water suply (1000x if from wells), soil and geological substrate (20x or more), meteorological conditions (10x if short-term measurements are used), building materials (5x in most cases), and ventilation rate (usually less than 3x). (DT)

27014 (CONF-811048—Summs., pp 3p, Paper 10) **Air filtration and radon daughter levels.** Johassen, N. (Technical Univ. of Denmark, Lyngby). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

An investigation of the effect of filtration on the randon daughter population in a virtually unventilated room is described. The main results showed an equilibrium factor decrease with increasing ventilation. It is shown that the extra reduction primarily is caused by the removal rate of ^{218}Po exceeding the filtration rate. (DT)

27015 (CONF-811048—Summs., pp 4p, Paper 11) **Measuring and modeling the time variations of airborne ^{222}Radon concentrations in houses in Maine, USA.** Hess, C.T.; Weiffenbach, C.V.; Norton, S.A. (Univ. of Maine, Orono). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Indoor and outdoor radon concentrations have been measured in air and water samples for more than 100 houses in Maine using a variety of radon detection methods. Concentrations ranged from 0.05 to 210 pCi/1. Concurently, water samples were collected from the wells for these houses and radon measured by the method of Pichard. (DT)

27016 (CONF-811048—Summs., pp 5p, Paper 12) **Indoor radon levels: effects of energy-efficiency in homes.** Fleischer, R.L.; Mogro-Campero, A.; Turner, L.G. (General Electric Research and Development Center, Schenectady, NY). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Energy-efficient homes tend to be significantly more radon-rich than are the more conventional homes, particularly in the first and second story living areas that are most relevant to human exposure. Summer radon levels in these homes are usually different from winter in a variable manner, so that a full year of integration is required for careful monitoring. (DT)

27017 (CONF-811048—Summs., pp 3p, Paper 13) **Indoor radon concentrations.** Moschandreas, D.J. (IIT Research Inst., Chicago); Rector, H.E. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Indoor sampling in an energy efficient Experimental Residence (ER) at a subrub of a Washington, DC showed high radon (Rn) and Rn progeny concentrations. This paper presents results from an indoor air quality-Rn concentration survey. Survey homes were recruited from three concentric zones centered on the Experimental Residence. This design sought to distribute surveyed homes spatially as evenly as possible. (DT)

27018 (CONF-811048—Summs., pp 5p, Paper 14) **Instrumentation for a radon research house.** Nazaroff, W.W.; Revzan, K.L.; Robb, A.W. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-48.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We have designed and built a highly automated monitoring and control system for studying radon and radon-daughter behavior in residences. The system's instrumentation is capable of measuring air-exchange rate, four-point radon concentration, individual radon daughter concentrations, indoor temperature and humidity, and outdoor weather parameters (temperature, humidity, wind speed, and wind direction). It is also equipped with modules that control the injection of radon and tracer gas into the test space, the operation of the forced-air furnace, the mechanical ventilation system, and the mixing fans located in each room. A microcomputer controls the experiments and records the data on magnetic tape and on a printing terminal. We injected radon into the test space up to a concentration of about 50 pCi/1 - the end of the range of concentrations found in houses. Setting the concentration at this level allows us to measure radon and radon daughters fairly precisely and is also high enough to assure that contributions of outdoor levels of radon and daughters will not affect indoor levels. (DT)

27019 (CONF-811048—Summs., pp 3p, Paper 15) **Modelling radon daughter concentrations in non-equilibrium situations.** Robertson, A.; Scott, A.G. (DSMA ATCON Ltd., Dundas, Toronto). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Simultaneous measurements of radon and radon daughter concentrations in several hundred houses found that the variability of the ratio of daughters to radon was much higher than was expected from the known measurement errors. A program was start-

ed to identify the causes of this variability, and if possible, to measure the variations of these parameters with time and location in the field. This was possible for aerosol concentration, ventilation rate, deposition velocity of free and attached daughters, and radon concentration. (DT)

27020 (CONF-811048—Summs., pp 4p, Paper 16) **Eberline's new microcomputer based radon daughter instrument.** Beard, R. (Eberline Instrument Corp., Santa Fe, NM); Geiger, E.L.; Waligora, S.J.; Fraim, F.; Gunther, B.; Tafreshi, A. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A microcomputer based radon daughter working levels (WL) monitor has been designed for use in a nationwide survey of indoor air pollutants. This method of measuring WL has been used since 1977 but the earlier version was not designed for use in homes. The new design makes it possible for a local person with minimal training to place, retrieve and read out many small (survey instrument size) WL monitors, using a single read-out device mounted in a suitcase. (DT)

27021 (CONF-811048—Summs., pp 4p, Paper 17) **Sources of indoor radon in houses.** Bruno, R.C. (Environmental Protection Agency, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Radon sources are listed along with their potential range of contribution to indoor radon levels in the model house located in both normal and mineralized regions. The totals without including the soil gas transport contribution are particularly interesting since they are much lower than the high end of the measurements of radon levels in the studies cited. This indicates that the transport pathway must generally be a major source of radon, and furthermore, that soil gas transport is probably by far the largets source in houses with the highest radon levels in a given region. (DT)

27022 (CONF-811048—Summs., pp 3p, Paper 18) **Activity of radon daughters in high rise buildings and the influence of soil emanation.** Abu-Jarad, F. (Univ. of Petroleum and Minerals, Dhahram, Saudi Arabia); Fremlin, J.H. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

From the previous results one may conclude that it is not necessarily true that the sub-floor emanation will increase the radon activity in the ground floor rooms and it seems clear that in the cases studied there is no appreciable effect due to emission from the sub-soil to the rooms above the first floor. The exposure from the radon daughters to the people living in the two-high rise buildings studies was less than the exposure to the people living in houses or flats near the ground surface. (DT)

27023 (CONF-811048—Summs., pp 4p, Paper 25) **Formaldehyde monitoring in domestic environments.** Matthews, T.G.; Howell, T.C. (Oak Ridge National Lab., TN). 1981. NTIS, PC A23/MF A01. Contract W-7405-ENG-26.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Three CH_2O monitoring methodologies have been developed which have undergone a successful preliminary field evaluation in domestic environments. A modified CEA Instruments, Inc. colorimetric analyzer is a potentially suitable device for quasi-real-time CH_2O monitoring in environmentally controlled homes. A practical methodology for the application of 13X molecular sieve as a CH_2O sorbent medium has been developed. The stability analyses suggest that CH_2O-exposed molecular sieve may be conveniently transported without environmental control from measurement sites to a laboratory for analysis. A pumped molecular sieve-based CH_2O collection unit has been developed for rapid sampling applications at CH_2O concentration levels of $\geqq$ 25 ppB. A visual colorimetric method has been suggested as a semi-quantitative formaldehyde screening analysis technique. The method is particularly suited for screening homes with respect to a recognized concentration guideline of $\geqq$ 100 ppB. (DT)

27024 (CONF-811048—Summs., pp 3p, Paper 52) **Indoor radon and lung cancer: models and methods.** Rasmussen, S.; Neuberg, D.; DuMouchel, W. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A13/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Research plans to evaluate the relationship between indoor radon levels of houses in Maine with the incidence of lung cancer are described.

27025 (CONF-811048—Summs., pp 6p, Paper 90) **Predicting radon fluxes and source locations using multichamber analysis.** Hernandez, T.L. (Princeton Univ., NJ); Ring, J. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Eight tracer gas injections in three Princeton houses revealed that houses with higher basement radon levels had the decay profiles of two-chamber systems. This was true regardless of the degree of coupling at the time of measurement between basement and living area. Dominant eigenvalues and eigenvectors determined from different injections in different chambers on the same day correlated well. Values obtained for transient parameters were far less reliable, with poor linear correlations for a particular injection and wide variation between separate injections common. (DT)

27026 (CONF-811048—Summs., pp 6p, Paper 91) **Dynamic simulation of radon daughter exposure in apartments using solar rockbed heat storage systems.** Rogozen, M.B. (Science Applications, Inc., Los Angeles, CA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The use of granitic rock as a heat storage medium in solar-based active heating systems has been cited as a potential source of radon gas emissions in houses and apartments. Previous mathematical modeling showed that certain constant infiltration rates and source strengths could lead to potentially hazardous equilibrium concentrations of radon and its daughters. The purpose of this study was to develop a more realistic model, in which hourly variations in infiltration rate and source strength were accounted for. In addition, radon emanation from granite was to be better characterized. (DT)

27027 (CONF-811048—Summs., pp 5p, Paper 95) **Integrated and grab sample radon data from dwellings in Maine and Texas.** Prichard, H.M. (Univ. of Texas School of Public Health, Houston); Hess, C.T.; Nyberg, P.; Weiffenbach, C.; Gessell, T. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The indoor radon concentrations in Maine are markedly higher than the corresponding levels in Houston. While differences in building style and the season of measurement exert some influence, it is tentatively assumed that geological and hydrological factors are primarily responsible for this difference. Assuming an equilibrium factor of 0.5 between radon and its daughters, it is seen that the average bedroom working level in Maine is 6 mWL, while 16% of the bedroom measurements suggest daughter levels in excess of 15 mWL. (DT)

27028 **(DOE/ID/12082—83) 1983 Environmental monitoring program report for Idaho National Engineering Laboratory Site.** Hoff, D.L.; Chew, E.W.; Dickson, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1984. Contract AS07-80ID12082. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009634.

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The results of the various monitoring programs for 1983 indicated that radioactivity from the Idaho National Engineering Laboratory (INEL) Site operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding the Site. Although some radioactive materials were discharged during Site operations, concentrations and doses to the surrounding population were of no health consequence and were far less than State of Idaho and Federal health protection guidelines. This report

describes the air, water, and foodstuff samples routinely collected at the INEL boundary locations and at locations distant from the INEL Site. 11 figures, 14 tables.

27029 **(DOE/NV/10327—4) Environmental surveillance report for the Nevada Test Site, January 1983 through December 1983.** Scoggins, W.A. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Apr 1984. Contract AC08-84NV10327. 211p. NTIS, PC A10/MF A01. Order Number DE84011606.

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This report documents the environmental surveillance program at the Nevada Test Site as conducted from January 1983 through December 1983. The results and evaluations of measurements of radioactivity in air and water, and of direct gamma radiation exposure rates are presented. Relevancy to DOE concentration guides (CG's) is established. 20 references, 15 figures, 22 tables.

27030 **(EML—427) Environmental Measurements Laboratory program review, December 1983.** Volchok, H.L.; de Planque, G. (EDS.). (USDOE Environmental Measurements Lab., New York). Mar 1984. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010758.

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This volume contains all of the written material that was submitted to the panel of Reviewers in advance of a Program Review conducted by the US Department of Energy, Office of Health and Environmental Research at the Environmental Measurements Laboratory (EML) December 7-9, 1983. In addition to a general introduction there are nineteen papers grouped into the five broad program categories covering all of the scientific and engineering projects of the Laboratory: Natural Radioactivity and Radiation, Anthropogenic Radioactivity and Radiation, Non-nuclear, Quality Assurance, and Development and Support. These short articles, for the most part, focus on the rationale for EML's involvement in each project, emphasizing their relevance to the EML and Department of Energy missions. Project results and their interpretation were presented at the Review and can be found in the material referenced in this volume.

27031 **(GAT—4012) Portsmouth Uranium Enrichment Complex environmental monitoring report for calender year 1983.** (Goodyear Atomic Corp., Piketon, OH (USA)). Apr 1984. Contract AC05-76OR00001. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010939.

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At the Portsmouth Uranium Enrichment Complex all effluent streams are sampled regularly and analyzed to assess compliance with applicable environmental standards. Radioactivity is measured in air, water, fish, produce, soil, and sediments; and radiation doses to the public are calculated. All public radiation doses from process effluents are well within Department of Energy standards. An extensive amount of engineering effort is also being exerted at the present time to modify existing airborne radioactivity emissions sources to further reduce emissions in compliance with DOE policy. Nonradioactive effluents either presently comply with federal standards or will comply upon completion of planned projects. CY-1983 was the third full year under the current National Pollutant Discharge Elimination System (NPDES) permit for liquid effluents, and the first year the Ohio Environmental Protection Agency (EPA) assumed responsibility for administering the NPDES Program. Compliance with the permit's discharge limits, with the exception of the high suspended solids in effluent from the South Holding Pond, did not present any significant problems. Overall compliance was 94.0 percent. Engineering is working on projects that are scheduled through 1985 for construction to further reduce the impact of liquid effluents. Although neither the State of Ohio nor the federal government has established standards for fluoride in the atmosphere or in vegetation, fluorides are monitored because they are used extensively in the uranium enrichment process. 13 references, 23 tables.

27032 **(GEPP-EM—806) Pinellas Plant environmental monitoring report, 1983.** (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). Apr 1984. Contract AC04-76DP00656. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011161.

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The results of the effluent and environmental monitoring programs are presented. Small quantities of tritium gas, tritium oxide, carbon-14 labeled solvent and krypton-85 gas were released from the plant during the year. Average maximum ground level concentrations of these radioisotopes were all less than 3/10 of 1 percent of the standard for continuous nonoccupational exposure. The plant's combined sanitary and industrial liquid effluents were analyzed for arsenic, barium, biochemical oxygen demand, boron, cadmium, total chromium, trivalent chromium, hexavalent chromium, copper, cyanide, iron, lead, manganese, mercury, nickel, phenolics, selenium, silver, sulfides, suspended solids and zinc. Small quantities of radioactive tritium were released to the POTW and from the East Pond. Analyses showed the levels were less than 1/10 of one percent of the applicable standards. Site perimeter and off-site air samples for tritium gas and tritium oxide, as well as off-site surface water samples obtained to distance of 9.6 kilometers (6 miles) from the plant site and analyzed for tritium content, showed levels significantly less than 1/10 of 1 percent of the standard for continuous nonoccupational exposure. Calculations were made to determine the radiation doses resulting from releases of tritium oxide, krypton-85 and carbon-14. The calculated doses are exceedingly small when compared to the applicable standards. The total dose commitment to the population residing within 80 kilometers (50 miles) was determined to be 0.40 man-rem as compared to the annual dose from natural radiation of 243,117 man-rem. 10 references, 3 figures, 12 tables.

27033 **(ISH—22) Assessment of variability of radiation doses emanating from emission of airborne radioactive substances during normal operation of nuclear facilities.** Bretschneider, J. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Feb 1983. vp. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.).

Mathematical methods are compiled and developed that help to determine statistical characteristics of parameters used in radioecological models. The analytic method of approximation may replace the Monte-Carlo method to assess mean value and standard deviation of radiation exposure in accordance with the statement reliability that can be achieved for radioecological models. It provides the advantage of less calculations, plus the advantage that only mean values and standard deviations of the model parameters need to be known. It also allows easy estimation of the influence of single model parameters on radiation exposure variability. The logarithmic Gaussian distribution is an appropriate approximative function for the probability distribution of radiation exposure. This is tone for radioecological models of various structures and also for different statistical characteristics of the parameters. 99% of the fractiles of the numerically calculated probability distributions are by less than a factor of 10 above the respective values anticipated for probability distributions.

27034 **(LA—9993-MS) Fallout prediction as of 1957.** Stopinski, O.W. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011000.

The development of models by which to predict fallout from tests of nuclear devices in the atmosphere has evolved from better understanding of the processes and from evaluation of data from previous explosions. The development of the models as of operation Plumbbob (1957) is discussed in the report, as well as a brief description of the models in use at that time. The draft report written in 1957 is being published as part of an effort to document atmospheric nuclear test data.

27035 **(PNL—4545) Multimedia radionuclide exposure assessment modeling. Annual report, October 1980-September 1981.** Whelan, G.; Onishi, Y.; Simmons, C.S.; Horst, T.W.; Gupta, S.K.; Orgill, M.M.; Newbill, C.A. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1982. Contract AC06-76RL01830. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010924.

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Pacific Northwest Laboratory (PNL) and Los Alamos National Laboratory (LANL) are jointly developing a methodology for assessing exposures of the air, water, and plants to radionuclides as part of an overall development effort of a radionuclide disposal site evaluation methodology. Work in FY-1981 continued the development of the Multimedia Contaminant Environmental Exposure Assessment (MCEA) methodology and initiated an assessment of radionuclide migration in Los Alamos and Pueblo Canyons, New Mexico, using the methodology. The AIRTRAN model was completed, briefly tested, and documented. In addition, a literature search for existing validation data for AIRTRAN was performed. The feasibility and advisability of including the UNSAT moisture flow model as a submodel of the terrestrial code BIOTRAN was assessed. A preliminary application of the proposed MCEA methodology, as it related to the Mortandad-South Mortandad Canyon site in New Mexico is discussed. This preliminary application represented a scaled-down version of the methodology in which only the terrestrial, overland, and surface water components were used. An update describing the progress in the assessment of radionuclide migration in Los Alamos and Pueblo Canyons is presented. 38 references, 47 figures, 11 tables.

27036 **(PNL—5079) US Department of Energy Quality Assessment Program data evaluation report.** Jaquish, R.E.; Kinnison, R.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 36p. NTIS, PC A03; 3; GPO Dep. Order Number DE84011400.

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The results of radiochemical analysis performed on the Quality Assessment Program (QAP) test samples are presented. This report reviews the results submitted by 26 participating laboratories for 49 different radionuclide-media combinations. 5 tables. (ACR)

27037 **(SAND—84-0429) 1983 environmental monitoring report, Sandia National Laboratories, Albuquerque, New Mexico.** Millard, G.C.; Gray, C.E.; O'Neal, B.L. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011170.

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Sandia National Laboratories (SNL) is located south of Albuquerque on Kirtland Air Force Base. Because radionuclides are potentially released from its research activities, SNL has a continuing environmental monitoring program which analyzes for cesium-137, tritium, uranium, alpha emitters, and beta emitters in water, soil, air, and vegetation. Measured radiation levels in public areas were consistent with local background in 1983. The Albuquerque population received an estimated 0.250 person-rem from airborne radioactive releases, whereas it received greater than 49,950 person-rem from naturally occurring radionuclides. 23 references, 6 figures, 15 tables.

27038 **(UCRL—50027-83) Environmental monitoring at the Lawrence Livermore National Laboratory. 1983 annual report.** Griggs, K.S.; Myers, D.S.; Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011165.

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The 1983 annual average airborne gross beta activity in Livermore Valley air samples, 1.4×10^{-14} μCi/ml, was less than 1982. Airborne ^{238}U concentrations at Site 300 were higher than those at Livermore because of the depleted uranium (a byproduct of ^{235}U enrichment) used in high-explosive tests at the Site. However, these concentrations were well below the standards set by DOE. The average gross alpha activity shows no significant change from 1982. The annual average beryllium concentrations were less than 1% of the local air pollution standard at both sites and can be accounted for by the natural concentrations in airborne dust. The total tritium released to the atmosphere in 1983 was 3245 Ci. Water samples exhibited gross beta and tritium activities within the ranges previously observed in these areas. Two water samples from Site 300 showed an above-average level of gross alpha activity. This activity is due to naturally occurring uranium. The discharge of tritiated water (HTO) into the sanitary sewer system in 1982 was 1.7 Ci, unchanged from the previous year. Tritium concentrations observed in local wells in 1983 were generally the same as previous years measurements. Tritium levels found in the Livermore Valley and Site 300 vegetation were comparable to 1982. The 1983 average annual gamma-radiation doses at the Laboratory perimeter and off-site locations were 51 mrem and 50 mrem, essentially unchanged from previous year. A 14-MeV neutron generator (Bldg. 212) near the south perimeter continued to be a source of elevated radiation. 19 references, 19 figures, 36 tables. (MDF)

27039 **(WINCO—1004) Revised ICPP effluent data 1976 through 1983.** (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-84ID12435. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010283.

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This report corrects all effluent data for the years 1976 thru 1982. Included herein are the gaseous radionuclide and service waste radionuclide and inorganic releases for this time period. Some numbers may differ from those previously reported due to the discovery of previous computational errors.

27040 **Stack effluent monitoring for an operating four reactor unit Candu Nuclear Station.** McDonald, A.M.; Booth, R.J.; Kupca, S.; Walker, R.A.P. (Atomic Energy of Canada Ltd. CANDU Operations Sheridan Park Research Community Mississauga, Ontario L5K 1B2). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 706-710(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Gaseous effluents from an operating four reactor unit CANDU power station are monitored for radioactive particulates, iodines, noble gases and tritium to ensure compliance with approved derived emission limits. The four types of stack effluent monitors used on each of ten stacks are described. The total stack flow at a four reactor unit station is about 10 times that at a single unit station, hence there is the need for monitors with an order of magnitude greater sensitivity at the four unit stations. This need has been met by optimizing standard measurement techniques for particulate and iodine detection, and by introducing a novel technique for noble gas loss determination that provides several orders of magnitude increased sensitivity over traditional methods of detection. In addition, the use of a simple silica-gel desiccant to extract moisture from the sample stream has proven highly accurate and reliable for tritium monitoring purposes.

27041 **High precision ^{85}Kr monitor.** Fernandez, S.J.; Anderson, M.D.; Chapman, T.D.; Emel, W.A.; Motes, B.G.; Tkachyk, J.W. (Exxon Nuclear Idaho Co., P.O. Box 2800, Idaho Falls, ID 83401). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 682-685(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The development of a ^{85}Kr off-gas monitor for nuclear fuel reprocessing plants is presented. Discussed are the parameters used in the design of the monitor, including the sensitivity, the dynamic measurement range, and the radionuclide composition of the off-gas stream. Detailed are the associated isokinetic sampling system, the components of the monitor, and the data acquisition microprocessor. Lastly, ^{85}Kr releases measured during in-plant demonstration of the monitor are compared with known ^{85}Kr releases.

27042 **Violinist: sophisticated pu field monitor.** Umbarger, C.J.; Trujillo, F.; Wolf, M.A. (Los Alamos Nat'l. Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 659-660(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A new, smart, portable multichannel analyzer based plutonium field monitor has been developed that will significantly improve field monitoring capability by accident response teams. Called the Violinist, the system uses the ever-popular thin NaI (Tl) detector developed some years ago. The electronics weigh 1.7 lb and fit inside a package 7"x5"x1-3/4" deep. The device has: 256 channel MCA; microcomputer control; 32x84 dot matrix LCD alphanumeric and spectral display; three independent cursor sets for region of interest definition; keyboard-entered constants (3); computation algorithms; and internal battery power (15 hr lifetime). The package has wide radiation monitoring applications.

27043 **New generation low power radiation survey instruments.** Waechter, D.A.; Bjarke, G.O.; Trujillo, F.; Umbarger, C.J.; Wolf, M.A. (Los Alamos Nat'l. Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 655-658(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A number of new, ultra-low-powered radiation instruments have recently been developed at Los Alamos. Among these are two instruments which use a novel power source to eliminate costly batteries. The newly developed gamma detecting radiac, nicknamed the Firefly, and the alpha particle detecting instrument, called the Simple Cordless Alpha Monitor, both use recent advances in miniaturization and powersaving electronics to yield devices which are small, rugged, and very power-frugal. The two instruments consume so little power that the need for batteries to run them is eliminated. They are, instead, powered by a charged capacitor which will operate the instruments for an hour or more. Use of a capacitor as a power source eliminates many problems commonly associated with battery-operated instruments, such as having to open the case to change batteries, battery storage life, availability of batteries in the field, and some savings in weight. Both line power and mechanical sources are used to charge the storage capacitors which power the instruments.

27044 **Preliminary analysis of four numerical models for calculating the mesoscale transport of Kr-85.** Pepper, D.W.; Cooper, R.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). *Atmospheric Environment;* **17**: No. 10, 1881-1895(1983).

A performance study of four numerical algorithms for multidimensional advection-diffusion prediction on mesoscale grids has been made. Dispersion from point and distributed sources and a simulation of a continuous source are compared with analytical solutions to assess relative accuracy. Model predictions are then compared with actual measurements of Kr-85 emitted from the Savannah River Plant (SRP). The particle-in-cell and method of moments algorithms exhibit superior accuracy in modeling single source releases. For modeling distributed sources, algorithms based on the pseudospectral and finite element interpolation concepts exhibit comparable accuracy. The method of moments is felt to be the best overall performer, although all the models appear to be relatively close in accuracy.

5005 Site Resource And Use Studies

27045 **(BNL—34530) Adirondack tourism: perceived consequences of acid rain.** Metz, W.C. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010292.

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This report seeks to place in perspective the perceived effects of acid precipitation on the tourist industry in the Adirondacks. The 9375-square mile park is host to almost nine million tourists annually, not including seasonal residents. Since the park was established almost 100 years ago, there have been many changes in tourist characteristics, available recreational facilities, kinds of activities, accessibility of the area, and land use and resource management policies. The tourist industry has been influenced by both controllable and uncontrollable factors. At present the overwhelming majority of recreational opportunities and natural resources important to the Adirondack tourist industry are relatively unaffected by acid precipitation. Fishing, a significant component of the tourist industry, is the most vulnerable, but any presumed adverse economic effect has to be weighed against the location of the impacted waters, total Adirondack fishing habitat, substitution available, habitat usage, fisherman characteristics, resource management, and the declining importance of fishing as an Adirondack recreational attraction. Concern is expressed as to whether present minimal acidification impacts are the precursor of major future impacts on Adirondack terrestrial and aquatic environments, and ultimately tourism. Tourism in the Adirondacks is increasing, while many other regional employment sectors are declining. It is becoming a more stable multiseason industry. Its future growth and character will be affected by government, private organization, business community, and resident controversies regarding land use and resource management attitudes, policies, budgets, and regulations. The acid precipitation issue is only one of many related controversies. 65 references, 2 figures.

5006 Regulations

REFER ALSO TO CITATION(S) 26972, 26973, 26979

27046 (CONF-811048—Summs., pp 4p, Paper 101) **Legal aspects of indoor air pollution in energy efficient residences.** Dreher, T.J. (AnaChem, Inc., Albuquerque, NM); Everett, J.J. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The present near absence of control of residential indoor air pollution cannot be expected to persist much longer. As more information regarding the recognition and control of indoor air pollutants becomes available, model codes, regulations, and civil law can be expected to assign the responsibility for the control of those pollutants to appropriate parties within the housing industry. Economic, regulatory, and judicial factors may be able to accomplish this assignment of responsibility without further federal legislative involvement. (DT)

27047 (CONF-811048—Summs., pp 2p, Paper 102) **Indoor air pollution: formaldehyde as an example of the approach in the Netherlands.** van der Kolk, J. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Early in 1978, the Minister of Public Health and Environmental Protection adopted the value of 120 $\mu g/m^3$ as highest acceptable concentration for houses, schools, hospitals etc. To achieve a situation where this limit would normally not be exceeded a quality standard for particle board was developed. The Minister of Housing prohibited the use of particle that did not meet the standard in the construction of houses where public funds were involved - which in the Netherlands is the case in over 80% of the houses built. (DT)

27048 (CONF-811048—Summs., pp 3p, Paper 103) **Approach to a national indoor air pollution policy.** Repace, J.L. (Environmental Protection Agency, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Ventilation rate standards might be considered for the control of indoor concentrations of pollutants which have such generalized emissions that they cannot be controlled by product standards. Such standards would include air cleaning and air-to-air heat exchangers. Product standards might be established to limit the emissions of pollutants from building materials and consumer products which are capable of causing concentrations which exceed known health effects thresholds under typical building ventilation

rates. This would be a preferred method of control. Building code standards might provide for automatic spot ventilation of indoor combustion appliances; control of non-industrial work practices producing pollutants not controllable by normal ventilation; installation of vapor barriers to prevent radon penetration of dwellings; proper location of air intakes and exhausts; and precautions to limit infiltration of fumes from parking garages. Indoor air quality guidelines or standards would define appropriate maximum concentrations of indoor air pollutants, for the protection of sensitive groups in such buildings as hospitals, schools, single and multifamily dwellings, commercial office buildings, and places of recreation. (DT)

27049 (CONF-811048—Summs., pp 4p, Paper 104) **Indoor air pollution and public policy: regulatory issues.** Sexton, K.; Repetto, R. (Harvard School of Public Health, Boston, MA). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Recognition that indoor air quality is frequently bad enough to present health risks has raised the question of government regulation. A start has already been made with federal regulation of indoor ozone emissions from appliances, and state and local government legislation dealing with specific indoor pollutants, such as formaldehyde. Building codes represent an additional form of regulation. However, although some of the serious pollutants found indoors are the same as those regulated in the atmosphere and indoor concentrations are often much higher, creation of a regulatory framework for indoor air quality poses special policy issues. This paper attempts to address some of those issues. (DT)

27050 **(PB—84-114354) Vinyl chloride: a review of national emission standards.** (TRW, Inc., Research Triangle Park, NC (USA)). Feb 1982. 266p. NTIS, PC A12/MF A01.

This VC NESHAP Review Study assesses the current VC regulation through an investigation of emission control techniques and technological developments in the industry. The study encompasses evaluations of existing and new control technologies, sources not regulated by the standard, and enforcement and compliance experince since promulgation of the standard. Information and data evaluated during this study were obtained through literature searches, plant visits, and interviews with industrial representatives and EPA Regional Office personnel. The results of this review study will form the basis for possible revision of the existing standard.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

27051 **(DOE/SF/10501—005) Paleontologic salvage, Southern California Edison Company Ten Megawatt Solar Generating Pilot Plant, Daggett, San Bernardino County, California.** Reynolds, R.E. (San Bernardino County Museum Association, Redlands, CA (USA)). Jan 1980. Contract FC03-77SF10501. 54p. (STMPO—488). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84009974.

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Paleontologic monitoring and salvage operations were performed by the San Bernardino County Museum Association during the construction phase of the Ten Megawatt Solar Generating Pilot Plant at Daggett, San Bernardino County, California. A large and varied assemblage of significant Pleistocene fossils was recovered. The paleontologic specimens have been housed at the San Bernardino County Museum for further study. Excavation at the solar generating site yielded 28 fossil taxa which lived adjacent to the Mojave River in Pleistocene times. The most significant find was a human skeleton which was stratigraphically associated with fossil remains of horse, camel, rabbit, and smaller vertebrates. Mammoth remains were found at greater depth. The fossil remains of small vertebrates including rodents, birds, reptiles, and toads are a significant contrast to the contemporaneous fossils from Pleistocene Lake Manix to the east. Radiometric dates suggest that the Camp Cady local fauna from the Manix Lake sediments may range from 13,000 to 20,000 years Before Present. The fluviatile sediments at Daggett probably correlate with the fluviatile portion of the Manix formation and the fauna is probably from the same time span. Carbon samples are being radiometrically dated and should indicate the age of the human skeleton and the extinct vertebrate taxa.

27052 **Comparative winter diets of elk in New Mexico.** Rowland, M.M.; Alldredge, A.W.; Ellis, J.E.; Weber, B.J.; White, G.C. (Colorado State Univ., Fort Collins). *Journal of Wildlife Management;* **47**: No. 4, 924-932(1983). Contract W-7405-ENG-36.

Winter diet quality of elk (Cervus elaphus nelsoni) was studied in the Jemez Mountains, New Mexico, during January-April 1980 on a recently-burned montane area (BURN) and an unburned upper montane area (BACA). Grasses dominated diets in the BURN, but nearly equal proportions of browse and grass were eaten in the BACA. Botanical composition of diets did not vary during the study at either site. Crude protein and in vitro digestible organic matter (IVDOM) in forages did not differ between locations. Grasses were more digestible than browse, but crude protein content was similar between forage classes. IVDOM and protein increased significantly in grasses with advancing season, but not in browse. Dietary protein ranged from 3.5 to 7.2% in the BURN and from 4.7 to 7.5% in the BACA and was consistently superior in the BACA. Diet IVDOM in the BURN surpassed that in the BACA. Increases in diet quality were correlated with changes in quality of grasses ingested by elk. Forage quality was more variable than was diet quality, indicating the ability of elk to maintain relatively constant diet quality when confronted with large fluctuations in forage quality. 1 figure, 3 tables.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 25236, 25531, 26826, 26989, 27010, 27063

27053 **(BDX—613-3067) Environmental summary for calendar year 1983: US Department of Energy Bendix Kansas City Plant, Kansas City, Missouri.** (Bendix Corp., Kansas City, MO (USA)). Apr 1984. Contract AC04-76DP00613. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010767.

Environmental monitoring for significant non-radioactive pollutants was conducted to allow evaluation of effluent effects on the environs of the Federal Complex. The monitoring data were compared to appropriate standards and guidelines. Ambient air and surface water analyses have shown no discernible effects on the environment from plant discharges. However, on-site ground water analyses conducted in CY1983 detected the presence of chlorinated solvents. The impact of the levels detected presently is unknown because no federal or Missouri State Standards exist for solvents in ground water. Studies to clarify this situation presently are being conducted. The plant's National Pollutant Discharge Elimination System permit required effluent monitoring of discharges entering Indian Creek and Blue River. Abatement activity and discharge monitoring reports have been routinely submitted to the State of Missouri as required by the permit. The Kansas City, Missouri, divisions of Air and Water Pollution Control routinely require monitoring and reporting of effluents to the atmosphere and to the City's Publicly Owned Treatment Works (POTW). In accordance with the technical requirements of the EPA regulations implementing the Resource Conservation and Recovery Act, hazardous waste disposal activities are reported to the EPA and the State of Missouri. 15 references, 4 figures, 4 tables.

27054 **(DOE/ER/10726—1) Reactor sharing grant 1980-82. Final report.** (State Univ. of New York, Buffalo (USA). Nuclear Science and Technology Facility). 1984. Contract FG02-80ER10726. 18p. NTIS, PC A02; 3; GPO Dep. Order Number DE84003023.

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Results of activation analysis of Hawaiian soil samples submitted by Dr. Walter Barnard, are presented. (DLC)

27055 **(DOE/OR/21363—1) Sulfur input, output and distribution in two oak forests.** Kelly, J.M. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). 1983. Contract AI05-83OR21363. 26p. (CONF-830692—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011139.

From 6. North American forest soils conference; Knoxville, TN, USA (19 Jun 1983).

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Atmospheric sources, based on a five-year study, introduce a total of 33.8 and 30.9 kg 2^1 y^{-1} of sulfur at the Cross Creek and Camp Branch sites. These inputs interact with the forest canopy resulting in average inputs to the forest floor of 29.2 and 22.5 kg ha^{-1} y^{-1}, respectively. Rainfall, dryfall particulates, and gaseous SO_2 contribute 37, 10, and 53% of the total atmospheric input at Cross Creek and 35, 11, and 53% at Camp Branch. Throughfall, stemflow, and litterfall contribute 58, 18, and 24%, respectively, to forest floor input at Cross Creek and 69, 12, and 19% at Camp Branch. Aboveground biomass has accumulated 42.1 kg ha^{-1} of sulfur at Cross Creek and 36.1 at Camp Branch, while belowground biomass contains 41.1 and 27.8 kg ha^{-1}, respectively. Litter layers were found to contain 22.0 and 14.9 kg ha^{-1}, while the average sulfur content of the mineral soil is 96% of the total ecosystem pool at both sites or 2646 kg ha^{-1} at Cross Creek and 1876.0 at Camp Branch. Comparison of the distribution, form, and factors influencing distribution revealed major differences when residual soils were compared to alluvial soils both within and between sites. Total sulfur content decreased with depth in all profiles as did the water soluble fraction, while insoluble inorganic sulfur increased with depth in the residual soils. Organic matter and exchangeable phosphate were strongly correlated with soluble sulfur distribution, while percent clay and pH provided the best correlations with insoluble inorganic sulfur distribution. Residual sulfur (the difference between the total and the sum of soluble and insoluble) appears to occur largely as an organically bound sulfate and its concentration and distribution is closely associated with soil organic matter content. 47 references, 13 figures, 5 tables.

27056 **(LA—10037-MS) Hydraulic testing of crushed Bandelier Tuff.** Abeele, W.V. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011022.

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This report emphasizes large-scale testing, using the instantaneous profile method, for determination of unsaturated hydraulic conductivity. To allow for comparison, unsaturated conductivity was measured in the laboratory using the pressure plate method. Laboratory techniques and large-scale testing for determination of unsaturated hydraulic conductivity using the instantaneous profile method have been studied. It was found that in both cases the hydraulic conductivity could best be expressed as a power function of the water ratio by volume. Both graphical and analytical methods were used to analyze the moisture and tensiometric data provided by the instantaneous profile method and led to the determination of the hydraulic conductivity values. 13 references, 6 figures, 9 tables.

27057 (LBL—13500, pp 4.107-4.110) **Acid precipitation: microcosm applications and field studies.** Harte, J.; Lockett, G.P.; Schneider, R.A.; Tonnessen, K. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division annual report, FY 1981.

Research focused primarily on two regions, the western slope of the high Colorado Rockies and the western slope of the Californa Sierra Nevada. In addition, acid precipitation research was carried out in the Tibetan Plateau of China. The goals of these efforts are: to document instances of acid precipitation in areas not investigated by others; to determine the degree of sensitivity (buffering capacity) of high mountain watersheds and lakes in these areas; to predict chemical and ecological effects of acid precipitation in these regions; and to find the sources of the observed acid precipitation events. A combination of laboratory and field methods were used with emphasis on the use of microcosms to carry out experiments under controlled conditions.

27058 **(PB—84-151299) Cementing reactions in the hazardous waste environment.** Malone, P.G. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Jan 1984. 16p. NTIS, PC A02/MF A01.

The use of chemical grout for bottom sealing waste sites requires careful consideration of interfering reactions from contaminated soil or ground water. The cementing reactions in the acrylates and urethanes are very specific. The presence of reducers, oxidizers and complexors can make the grouting solution ineffective. Sodium silicate grouts that form by gel formation from a soil are not affected by oxidizing or reducing compounds. They are however sensitive to pH and the concentration of divalent and trivalent cations. The major problem with silicate grouts is accelerated setting which prevents the grout from penetrating the zone being sealed. The variety of possible grout/waste reactions is so broad that field testing with water and soil (or sediment) samples from the zone to be grouted is the most practical approach to selecting grout formulations and designing the grout program.

27059 **(PB—84-152172) Leaching aluminum from calcined kaolinitic clay with nitric acid. Report of investigations/1983.** Olsen, R.S.; Gruzensky, W.G.; Bullard, S.J.; Beyer, R.P.; Henry, J.L. (Bureau of Mines, Albany, OR (USA). Albany Research Center). Dec 1983. 21p. (BM-RI—8834). NTIS, PC A02/MF A01.

Prior work by the Bureau of Mines demonstrated a feed preparation method that eliminates the formation of slime during leaching of calcined kaolinitic clay and makes leached residues fast settling and easy to filter. Nitric acid leaching rates determined for calcined kaolinitic clay prepared by this method were found to correspond to a zero-order reaction model for both batch and continuous, stirred-tank leaching. A rate constant of 0.136/min was determined. Separation of solid residues from the reacted slurry was examined, and filtration rates were determined.

27060 **(PNL-SA—11728) Quinoline partitioning in subsurface materials: adsorption, desorption, and solute competition.** Felice, L.J.; Zachara, J.M.; Schmidt, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 19p. (CONF-8403114—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010773.

From International conference on ground water quality; Tulsa, OK, USA (26 Mar 1984).

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The adsorption/desorption behavior of quinoline, a basic N-heterocycle common to energy-derived liquid and solid waste, was evaluated at low solution concentration (0.066 μg/ml-12.9 μg/ml) on nine subsoil materials. The subsoils were low in organic carbon and varied in pH, texture, and chemical properties. Adsorption was studied under nitrogen using 0.01 M $CaCl_2$ as an electrolyte. The adsorption isotherms were curvilinear and were adequately represented by the Freundlich equation. Adsorption was high (> 95%) in acidic subsoils (pH < 6) and low in basic subsoils (pH > 7). Quinoline sorption did not correlate with subsoil organic carbon content, surface area, or clay content. However, desorption was significantly more reversible in the basic subsoil. Quinoline sorption on a basic subsoil was uneffected by the presence of pyridine. Pyridine reduced quinoline sorption on an acidic subsoil, with the greatest effect occurring at low quinoline concentrations.

27061 **(UCID—20031) Selection of representative organic compounds for in-depth studies of mobility in soil-water systems.** Harrison, F.L.; Mallon, B. (Lawrence Livermore National Lab., CA (USA)). Mar 1982. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011625.

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A group of organic compounds was selected for in-depth study of their mobility in soil-water systems based primarily on their prevalence in wastes from energy technologies. To identify waste chemicals common to several energy technologies, we used the combined information from our study of the organic combustion by-products in fly ash and studies by others of organic compounds in wastes from oil-shale retorting, coal combustion and con-

version, coke production, petroleum processing, etc. Other important criteria in the selection process were the compounds' physical properties, chemical functional groups, resistance to degradation, toxicity, and mutagenicity carcinogenicity. Those given higher priority were phenol, aniline, naphthalene, quinoline, benzothiophene and benzo(a)pyrene; those given lower priority were hexadecane, pentane, tridecanoic acid, benzoic acid, o-phthalic acid, pyridine, and thiophene. Information available indicates that the fate and distribution of these compounds can be related to their physical-chemical properties. 39 references, 9 tables.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 25489, 25532, 26065, 26979, 27010, 27028, 27031, 27032, 27033, 27035, 27036, 27037, 27038, 27039, 27167, 27169

27062 (FERMILAB—84/34) Environmental monitoring report for calendar year 1983. Baker, S.I. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 May 1984. Contract AC02-76CH03000. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010925.

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This report gives the results of the environmental monitoring program at Fermi National Accelerator Laboratory (Fermilab) for Calendar Year 1983. The accelerator began an extended shutdown for installation of a superconducting magnet ring in June 1982. Injection of protons into the new accelerator ring began one year later. Extraction of protons to the Experimental Areas occurred in October 1983. The total number of protons accelerated in 1983. The total number of protons accelerated in 1983 was 4×10^{17}. This total is approximately 2% of the average of 1.9×10^{19} for the preceding five years. Thus, environmental monitoring in CY-1983 was done mainly to check on effects resulting from previous accelerator operations. During CY-1983 there were no abnormal occurrences which had an impact on the facility and its operation.

27063 (PNL-SA—11889) Hanford Environmental Data System. Cowley, P.J.; Sula, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1983. Contract AC06-76RL01830. 7p. (CONF-840202—23). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008299.

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

This comprehensive on-line, interactive data base used by the Pacific Northwest Laboratory's Hanford Environmental Surveillance Program. This program provides for monitoring and evaluation of environmental radiological parameters in the Hanford environs for the purpose of assessing environmental impacts of site operations. Through software developed to utilize the data base, the system generates pre-printed labels from an internally stored sample collection schedule and tracks the collection and analysis of samples - providing notification in the event a sample is not collected or analyzed according to schedule. The system screens all incoming data using sample-specific criteria and generates a report for any data not meeting all criteria. Comments may be stored with any environmental measurement result entry.

27064 (SAND—84-0430) Sandia National Laboratories Tonopah Test Range, Tonopah, Nevada: 1983 environmental summary. Millard, G.C.; Lathrop, L.W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011152.

The Tonopah Test Range is located about 160 air miles northwest of Las Vegas, Nevada, and covers 525 square miles within the Nellis Air Force Base Bombing and Gunnery Range. The range is used for various DOE tests involving high and low altitude projectiles. Operations that affect the environment are mainly road construction, preparation of instrumentation sites, and disturbance of the terrain from projectile impacts. Monitoring of the test range is done annually by the US Environmental Protection Agency to supplement Sandia's monitoring effort. Monitoring results indicate that test range operations do not adversely affect the offsite environment or the public. 7 references.

27065 (UCID—20071) Update and inclusion of resuspension model codes. Porch, W.M.; Greenly, G.D.; Mitchell, C.S. (Lawrence Livermore National Lab., CA (USA)). Dec 1983. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011602.

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Model codes for estimating radiation doses from plutonium particles associated with resuspended dust were improved. Only one new code (RSUS) is required in addition to the MATHEW/ADPIC set of codes. The advantage is that it estimates resuspension based on wind blown dust fluxes derived for different soil types. 2 references. (ACR)

27066 (UCRL—53529) Results of calculations of external gamma radiation exposure rates from fallout and the related radionuclide composition from the SIMON Event of Operation Upshot-Knothole, 1953. Hicks, H.G. (Lawrence Livermore National Lab., CA (USA)). 9 Apr 1984. Contract W-7405-ENG-48. 21p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010772.

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This report presents data on calculated gamma radiation exposure rates and ground deposition of related radionuclides resulting from the SIMON Event that deposited detectable radioactivity outside the Nevada Test Site complex. This report differs from our previous calculations in that additional results are presented for eight time periods shorter than one hour.

27067 Evaluation of an automated assay system to measure soil radionuclides by L x-ray and γ-ray spectrometry. Nyhan, J.W.; Drennon, B.J.; Crowell, J.M. (Los Alamos National Lab., NM). *Soil Science Society of America Journal;* **47**: No. 3, 486-490(May-Jun 1983). Contract W-7405-ENG-36.

An automated radionuclide assay system was evaluated for performing soil radioassays using L x-ray and gamma-ray spectrometry. Wet chemistry assay procedures were shown to be considerably more time consuming than similar analyses of soils on this radionuclide assay system. The detection limits of ^{241}Am and Pu were determined, as well as the reproducibility of radionuclide assay results. The L x-ray spectrometric measurements were compared with radiochemical analysis on several tuff samples. The assay system's intrinsic germanium detector was found to respond linearly to varying low concentrations of ^{241}Am and Pu, both of which were easily detected in the presence of elevated concentrations of ^{137}Cs. 9 references, 7 figures, 1 table.

27068 Distribution of alpha activity from neptunium on rock fissures. Seitz, M.G. (Argonne National Lab., IL (USA)); Seliga, M. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice (Czechoslovakia)). *Nuclear Tracks;* **7**: No. 4, 155-161(1983).

Using the track-detecting plastic CR-39, we have examined the reaction of trace quantities of neptunium in solution with surfaces of an old fissure of granite rock. Radionuclides that were dissolved in a groundwater solution by leaching of solids that contained a variety of radionuclides were transmitted in flowing water into the rock fissure. The rock fissure was then dried and the rock split at the fissure for analysis by radiochemical and radiographic techniques. Radiochemical analyses have shown neptunium-237 to be the alpha-active nuclide adsorbed on the rock surface. An alpha radiograph of one fissure surface, analysed in detail, indicates that neptunium was adsorbed along the entire length of the rock fissure rather than strongly adsorbed at the inlet to the rock fissure as was another radioelement, cesium (as seen in a beta radiograph). Some inhomogeneities of neptunium concentration were observed on the fissure surface. They may be indicative of local mineralogical variation of the rock, which can affect adsorption of neptunium. Quantification of the alpha activity on the fissure surface by track counting on plastic and by radiochemical separation and electronic counting established that virtually all of the ^{237}Np on the rock fissure was detectable by the CR-39 plastic. This indicates that the

neptunium was on the surface of the rock fissure and did not penetrate deeply into the rock surface.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 25257, 25515

27069 (BNL—51755) 1983 breeding bird censuses and summary of 1977-1983 results. Raynor, G.S. (Brookhaven National Lab., Upton, NY (USA)). Nov 1983. Contract AC02-76CH00016. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011529.

As part of a program to characterize the plant and animal life of the Laboratory site and the surrounding region, the two breeding bird censuses originated in 1977 were continued in 1983. Coverage was above average at BNL and below at Westhampton. Seventeen trips were made to the BNL plot and nine to the Westhampton plot. Five observers censused the BNL and two the Westhampton plot. The number of species on the BNL plot was near the seven-year average. The number of territorial males was the second highest. At Westhampton, the number of species was normal but the number of territorial males was the lowest ever due to a large decline in Prairie Warblers believed due to loss of scrub oak foliage caused by a late frost. A seven-year summary is included. 13 references, 7 tables.

27070 (EGG—10282-2032) Surveys for Astragalus beatleyae on Nellis Bombing Range, Nye County, Nevada. O'Farrell, T.P.; Collins, E. (EG and G, Inc., Goleta, CA (USA). Energy Measurements Group). Apr 1984. Contract AC08-83NV10282. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011622.

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Aerial and ground surveys of western portions of the US Air Force's Nellis Bombing Range, Nye County, Nevada, were conducted to determine if the rare plant, Astragalus beatleyae (Barneby), was widely distributed there. Additional information on its distribution will assist the US Department of Energy and the Fish and Wildlife Service in assessing the need to provide federal protection for this plant under the Endangered Species Act of 1973. Eleven areas were surveyed on foot between 18 and 20 July 1983 in potential habitat identified during a helicopter reconnaissance. Astragalus beatleyae was found in seven discrete groups at three major locations on contiguous portions of Pahute Mesa. Plants were distributed between 4.75 and 8.5 miles west of the species' type locality on the Nevada Test Site. One population was growing on an atypical habitat having deep, clay soils. 11 references, 4 figures.

27071 (TVA/PUB—84/25c) Guntersville Reservoir land management plan. Appendix 2. (Tennessee Valley Authority, Norris (USA). Div. of Land and Forest Resources). 1984. 42p. NTIS, PC A03/MF A01. Order Number DE84900930.

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The TVA reservoir planning process seeks to formulate long-range management plans for the thirty-three thousand (33,000) acres of TVA land surrounding Guntersville Reservoir. This report presents recommendations for the management of Guntersville Reservoir's visual resources as a part of the reservoir planning process. The recommendations can be used as integral considerations in the development of land management plans and land use allocations, particularly in the resolution of land use conflicts.

5106 Regulations

REFER ALSO TO CITATION(S) 27050

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 27229

27072 Determination of natural actinides and plutonium in marine particulate material. Anderson, R.F.; Fleer, A.P. (Woods Hole Oceanographic Inst., MA). *Analytical Chemistry;* **54**: No. 7, 1142-1147(Jun 1982). Contract AC02-76EV03566.

The natural actinides ^{227}Ac, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}Th, ^{231}Pa, ^{238}U, and ^{234}U and the α-emitting plutonium isotopes are determined in samples of suspended marine particulate material and sediments. Analysis involves total dissolution of the samples to allow equilibration of the natural isotopes with added isotope yield monitors followed by coprecipitation of hydrolyzable metals at pH 7 with natural Fe and Al acting as carriers to remove alkali and alkaline earth metals. Final purification is by ion exchange chromatography (Dowex AG1-X8) and solvent extraction for Pa. Overall chemical yields generally range from 50 to 90%. The method has been successfully interfaced with published methods to include the determination of ^{55}Fe, ^{137}Cs, ^{90}Sr, and ^{241}Am on the same samples.

27073 Comparison of chlorophyll a measurements by fluorometric, spectrophotometric and high pressure liquid chromatographic methods in aquatic environments. Jacobsen, T.R. (Univ. Of Georgia, Athens). *Ergebnisse der Limnologie;* **16**: 35-45(Jun 1982). Contract AS09-76EV00639.

Significant differences ($P>F$ 0.0001) between chlorophyll a values by high pressure liquid chromatography (HPLC) and other chlorophyll methods were found on paired determinations of water samples from the continental shelf of the southeastern United States. Synoptic chlorophyll a determinations by fluorometric and HPLC methods showed considerable differences in perceived photoautotrophic distributions on an area basis. Values in some paired determinations differed by almost 2 orders of magnitude while other samples differed by less than 0.01 $\mu g\ l^{-1}$. Examination of chlorophyll distributions by in vivo and extracted fluorometric, spectrophotometric and HPLC methods in nearshore studies showed considerable differences in estimated values and perceived distributions of photoautotrophs. These studies emphasize the need for chromatographic separation of chlorophyll a pigments from the matrix of degradation products found in the aquatic environment.

27074 Oceanic distribution of ammonium-oxidizing bacteria determined by immunofluorescent assay. Ward, B.B. (Univ. of Washington, Seattle). *Journal of Marine Research;* **40**: No. 4, 1155-1172(1982). Contract AT06-76EV75026.

Marine ammonium-oxidizing bacteria in seawater were enumerated by means of immunofluorescent assays developed for Nitrosococcus oceanus and Nitrosomonas marina. Samples were collected from the coastal waters off the states of Washington and California, from the central North Atlantic and northeast Pacific Oceans, and from Chesapeake Bay. Total abundances of ammonium oxidizers ranged from 10^7 cells l^{-1} in Chesapeake Bay and 10^5 cells l^{-1} in inshore ocean waters to 10^3 to 10^4 cells l^{-1} in the open ocean. Using mean abundances from surface waters, a potential nitrification rate was calculated. Results imply that microbial nitrification rates in the water column can be substantial and may be sufficient to balance the annual new production demand for nitrate.

27075 Phytoplankton patchiness and frontal regions. Seliger, H.H.; McKinley, K.R.; Biggley, W.H.; Rivkin, R.B.; Aspden, K.R.H. (Johns Hopkins Univ., Baltimore, MD). *Marine Biology (Berlin);* **61**: 119-131(1981). Contract AC02-76EV03278.

In the Chesapeake Bay estuary there are persistent seasonal frontal and interfrontal regions that serve to deliver and retain different phytoplankton populations. The patchiness of phytoplankton, both in total chlorophyll a concentrations and in species compositions and abundances, is shown to be causally related to density flow forcing which results in these frontal and interfrontal regions. The delineation of these regions by on-line, two-dimensional profiling of density isopleths serves to identify stations within these regions for biological and chemical sampling as opposed to sampling on an arbitrary geographical grid. It is possible, by superposition of nutrient and organism concentration isopleths upon salinity isopleths, to infer conservative and non-conservative features of the system.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 25324, 25337, 25529, 25530, 26989, 27010, 27031, 27053, 27057, 27058, 27061, 27210

27076 (LBL—13500, pp 4.104-4.106) **Optimum microcosm design for ecotoxicology.** Harte, J.; Levy, D.J.; Lockett, G.P.; Oldfather, J.M.; Rees, J.T.; Saegebarth, E.I.; Schneider, R.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division annual report, FY 1981.

A facility was designed and constructed where microcosms are housed in two separate rooms, each capable of containing 12 tanks holding up to 50 liters in volume. Greater temperature control, reduced energy consumption, more uniform illumination intensity, a clock regulated illumination schedule, and a relatively dust-free environment are improved features. Baseline studies emphasized spatial distribution of plankton with effects created by variations of agitation, light, temperature and chemicals simulated. (PSB)

27077 (LBL—13500, pp 4.119-4.120) **Organic compounds in coal slurry pipeline water.** Newton, A.S.; Villarreal, H.M.; Walker, W.E.; Fox, J.P. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

This study shows that organic compounds, other than phenols, do not occur in environmentally significant levels in coal slurry waters from the subbituminous coals tested. Phenols do occur at the concentration levels of 1 to 100 ppb (μg/1). This concentration level is below the safe level set by EPA. If these slurry waters are chlorinated, these phenols will be converted to various polychloro phenols.

27078 **Extraction efficiency of anthracene form sediments.** Haddock, J.D.; Landrum, P.F.; Glesy, J.P. (Savannah River Ecology Lab., Aiken, SC). *Analytical Chemistry;* **55**: No. 7, 1197-1200(Jun 1983).

In a study to determine the effects of spiking techniques, extraction solvent composition, and sediment matrix variations on extraction efficiency of polynuclear aromatic hydrocarbons (PAH), anthracene was chosen as a model PAH. The extraction of anthracene from the sediments was dependent on the treatment of the samples and ranged from 30.9+/-4.0 to 97.2+/-8.7% at a 95% confidence level. Of the variables examined, mixing duration of spiked slurries was found to be the most significant factor. Significant effects on extraction efficiency were also noted for variations in extracting solvent composition, sediment type, and sediment moisture. The variables were found to affect each other in a nonadditive manner; thus, no accurate predictions of variable effects can be made from knowledge of the main effects alone.

27079 **Chemistry of western Atlantic precipitation at the mid-Atlantic coast and on Bermuda.** Church, T.M. (Univ. of Delaware, Newark); Galloway, J.N.; Jickells, T.D.; Knap, A.H. *Journal of Geophysical Research;* **87**: No. C13, 11,013-11,018(20 Dec 1982).

The major ion composition of western Atlantic precipitation falling at the coast of eastern United States (Lewes, Delaware) and at the Sargasso Sea (Bermuda Island) has been measured by event year round (May 1980 to April 1981) to assess the influence of the ocean on precipitation from storms that leave the North American continent and transit over the western Atlantic. Particular attention is paid to the oceanic influence on the sulfur and nitrogen precursors of acid rains. While sea salt contributes over half (by weight) of the salt in precipitation at the coast and over three quarters at Bermuda, most of the sulfate (90% at the coast and 50% at Bermuda) is in excess to sea salt sodium. Since Bermuda precipitation is still acidified some factor of 8 relative to pure equilibrium with atmospheric carbon dioxide, this strong acidity has been attributed to the long-range transport sulfur and nitrogen precursors in the marine troposphere during which the sulfuric acid component dominates. A sulfur budget for the western Atlantic troposphere shows that of the total amount of sulfur exported from the North American continent (>3.9 TgS/yr) less than 3% (0.1 TgS/yr) is from natural sources, the rest being from anthropogenic emissions. If Bermuda precipitation is taken as typical of wet fallout of sulfur over the western Atlantic, then no more than half (<2 TgS/yr) of North American excess (nonsea salt) sulfur export falls out to the western Atlantic and at least half undergoes potential transoceanic transport as acid rain precursors to the east of Bermuda.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 25481, 25482, 25489, 25532, 25533, 25572, 25991, 26826, 27010, 27028, 27029, 27031, 27032, 27033, 27035, 27036, 27037, 27038, 27039, 27062, 27064

27080 **Aquatic chemistry of plutonium in seasonally anoxic lake waters.** Sholkovitz, E.R.; Carey, A.E.; Cochran, J.K. (Woods Hole Oceanographic Inst., MA). *Nature (London);* **300**: No. 5888, 159-161(11 Nov 1982). Contract AC02-81EV10694.

Data are presented on the distribution of the fallout radionuclides ^{55}Fe, $^{239,240}Pu$, ^{137}Cs and ^{90}Sr and the natural radionuclides ^{238}U and ^{234}U in a seasonally anoxic lake in an effort to determine their biogeochemical behavior. Results from Gull Pond, Massachusetts show that the oxygen-depleted and iron- and manganese-rich bottom waters contain five times more dissolved $^{239,240}Pu$ than oxygenated surface waters. This feature, also observed in anoxic hypolimnia of other lakes, indicates that the concentration of plutonium is significantly influenced by anoxicity and redox cycles. Such observations are important in understanding the fate of artificial radionuclides which are released to the aquatic environment through global fallout, planned disposal and localized accidents.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 25989

27081 **(SREL—14) Evaluation of the Steel Creek ecosystem in relation to the proposed restart of the L-Reactor: interim report.** (Savannah River Ecology Lab., Aiken, SC (USA)). Sep 1983. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011126.

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This interim report of findings from studies by SREL has updated information on several key components of the Steel Creek ecosystem. We have emphasized two categories of the Steel Creek biota: Endangered Species (American alligator) and species for which environmental degradation within SRP boundaries might result in changes in offsite resource abundance. Wintering waterfowl surveys in the vicinity of the Steel Creek delta have demonstrated a pattern of increased utilization over the duration of these studies (1981-83). Wood stork utilization of SRP swamp areas also appeared to be substantially increased relative to previous years. Thermal alteration of the Steel Creek delta areas will eliminate this area as wood stork foraging habitat. Anadromous fish utilization of the Steel Creek area was also substantially increased in 1983 relative to 1982. The differences in anadromous fish species utilization patterns between 1982 and 1983 are probably a result of the markedly different river flow conditions between the two years. Studies of the American alligator have continued. No further reproduction

by alligators has been observed in the Steel Creek system. 24 references, 14 figures, 13 tables.

27082 **Fish abundance and distribution near three heated effluents to Lake Michigan.** Spigarelli, S.A.; Goldstein, R.M.; Prepejchal, W.; Thommes, M.M. (Argonne National Lab., IL (USA)). *Canadian Journal of Fisheries and Aquatic Science;* **39**: No. 2, 305-315(Feb 1982).

A combined echo location-temperature mapping technique was used to determine the abundance and distribution of fish with depth and temperature in locally heated and unheated areas of Lake Michigan. Surveys were conducted between April and October at two adjacent power plants in the southern basin and at one plant in the northern basin of the lake. Fish densities in plume and reference areas differed seasonally. Densities typically differed by a factor of 2-4 although on one occasion plume area density was 90 times greater. Highest plume densities occurred during late spring when alewife (Alosa pseudoharengus) were spawning inshore. Consistently dense congregations of fish were found downstream of the interfaces between ambient shore-parallel currents and discharge flows. The general distribution of fish with depth was similar in all areas. Differences between plume and reference areas were related to the discharge type: at canal discharges fish tended to congregate inshore while at the offshore discharge they congregated in deeper zones. Fish also tended to occupy shallower depth strata in all plume areas. Positive correlation between fish density and increasing temperature was common at both plume and reference areas during all three seasons, but more frequent at plume areas. Temperatures selected by fish in plume areas were 1-3°C higher than maximum ambient temperatures.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 27091

27083 **(FERC/EIS—0037-Final-Draft) Eagle Rock hydroelectric project, FERC No. 2789 - Idaho. Final environmental impact statement.** (USDOE Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation). Mar 1984. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84009774.

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The Raft River Rural Electric Cooperative, Inc. proposes to construct a hydroelectric project with a total installed capacity of 47.8 megawatts (MW) on the Snake River in the vicinity of American Falls, Idaho. The proposed project would consist of: (1) a 600-foot-long, 20-foot-high, ungated, gravity-arch, concrete spillway structure at River Mile (RM) 708.6 on the north channel; (2) a 550-foot-long, 40-foot-high, rockfill dam at RM 708.5 on the south channel; (3) a reservoir extending 4.7 miles upstream at a normal surface elevation of 4.242 feet; (4) a 3,100-foot-long power canal extending from the south channel; (5) a powerhouse at the power canal, containing two turbine-generating units, each with an installed capacity of 23.5 MW, and a powerhouse at the spillway, containing one turbine-generating unit with an installed capacity of 800 kilowatts (kW); and (6) a 3-mile-long transmission line interconnecting with an existing Idaho Power Company (IPC) distribution line. The proposed project would have an average annual output of 195,100 megawatthours (MWh). The proposed Eagle Rock Project would unavoidably impact the present resources and uses of the project reach of the Snake River. The loss of 4.7 miles of free-flowing river, the loss of natural reaeration, and the loss of a Class I trout fishery, which Staff considers irreplaceable, would not be fully mitigated. Additionally, whitewater boeating would be eliminated; bald eagle and waterfowl use of the project reach would be restricted; the loss of riparian communities would reduce wildlife populations; and prehistoric and historic resources would be impacted significantly. 97 references, 29 figures, 24 tables.

27084 **(FWS/OBS—83/04) Natural and modified pocosins: literature synthesis and management options.** Ash, A.N.; McDonald, C.B.; Kane, E.S.; Pories, C.A. (East Carolina Univ., Greenville, NC (USA). Dept. of Biology). Jun 1983. 173p. National Coastal Ecosystems Team, US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458.

Pocosins are ecosystems endemic to the southeastern Coastal Plain of the United States. A characteristically sparse canopy of pond pine and an impenetrable layer of evergreen shrubs and vines are the hallmarks of this wetland type. Due to their hostile nature, pocosins have historically received little human attention or use. Recent changes in technology and human needs have made pocosins attractive targets for alteration to agriculture, forestry and peat mining operations. Unfortunately, little is known concerning environmental effects of pocosin alteration, the needs of pocosin wildlife, or the effects of pocosin alteration on adjacent ecosystems. This document attempts to shed light on some of the problems of altering pocosins to human use by synthesizing the available literature on natural and modified pocosins, and by outlining management options for wildlife in natural and modified pocosin settings. 269 references, 68 figures, 20 tables.

27085 (LBL—13500, pp 5.5-5.7) **Estuarine impacts of fossil-fuel-based technologies: a case study.** Ritschard, R.L.; Berg, V.J.; Henriquez, M.A. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The potential cumulative ecological impacts on a specific estuarine system resulting from fossil-fuel-based technollogies was studied. The upper reaches of San Francisco Bay were used as a case study because the majority of such activities in California occur in this region. The specific study area used in this project is divided into six zones in the northern reach. Available data indicate that energy-related discharges, as well as other industrial wastes, may not be the most significant contributors to pollutant loading of the Bay. Municipal outfalls and Delta outflow seem more important to the well-being of the Bay ecosystem, at least in terms of the volume and mass loading of different effluents.

27086 (LBL—13500, pp 5.8-5.11) **Environmental impacts of Marine Biomass.** Ritschard, R.L.; Berg, V.J.; Killeen, S. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

The workshop was conducted with three objectives. First, the participants were asked to identify both positive and negative potential environmental issues of an open ocean biomass system that employs artificial upwelling. Second, each issue was evaluated by an extensive discussion to determine how critical the issue was to the success of the marine biomass program. Finally, the attendees submitted recommendations for research in the environmental aspects of the kelp farm system.

5206 Regulations

REFER ALSO TO CITATION(S) 25325

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 25343, 25629, 26109, 26110, 26111, 26112, 26981, 26991

27087 **(DOE/MI/02503—T1) Implications of the energy crisis on minorities in southcentral Texas.** Williams, S.R.; Slaughter, D. (Prairie View A and M Univ., TX (USA). Center for Energy Affairs). 1981. Contract FG01-80MI02503. 56p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011129.

The purpose of the present research was the examination of the social and psychological correlates of the energy crisis, the analysis of whether the costs of energy force the choice between energy and other goods and services and to assess the survey population's attitude to and knowledge of alternative energy sources. The data source was the minority population in Harris

County, Texas. The results of the study indicate that low-income minorities do perceive some disruption in personal or interpersonal functioning that is due to the rising cost of energy. In examining social correlates of the energy crisis seventy-eight percent of those studied felt that their life-styles had been affected by the energy crisis. Most respondents felt worried or upset over the rising costs of energy, perceived tension in their households and were not as satisfied with their life as before the energy crisis. Almost one-half of the respondents reported more family quarrels as a result of rising energy costs. A large percentage of respondents reported consuming less energy in 1981 than in 1974. In terms of energy use patterns many of the respondents did make an effort to reduce energy consumption. Black respondents reported greater conservation efforts than Mexican-American respondents. The data indicates that when individuals are familiar with energy alternatives they are, by and large, willing to use those alternatives. The notable exception was nuclear energy; those respondents familiar with nuclear energy were almost evenly divided on willingness to use nuclear energy.

27088 **(LA-UR—84-1231) Impact of technology on the Hispanic community.** Vigil, J.C. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 17p. (CONF-8404138—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84011331.

From 8. national engineering symposium of the Mexican American Engineering Society; Albuquerque, NM, USA (11 Apr 1984).

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Technological innovation and its introduction into all aspects of American society are escalating rapidily. Traditional job areas are shrinking and new areas are developing that require greater preparation and sophistication. Increasingly higher educational levels are being required to compete for traditional jobs because of the increasing complexity of our society. Education, particularly in mathematics and science, is essential to participate knowledgeably and fully in a high-technology society. Individuals in our society who do not possess the levels of skills, literacy, and training essential to this new era will be effectively disenfranchised, not simply from material rewards, but also from a chance to participate fully in our national life. Hispanics have historically been under-represented in high technology jobs. The situation will not improve unless greater efforts are made to interest Hispanic youth in science and engineering. This will require a multi-pronged approach, since the insufficient participation of Hispanics in science and engineering is rooted in mutually reinforcing economic, social, and cultural factors.

27089 (LBL—13500, pp 5.17-5.20) **Growth and energy development in the rural west.** Sextro, R.G.; Bernier, J.M. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

This paper reviews the changes in rural employment and population growth over the past decade. Possible future energy activities and their implications for the rural areas of the western states are discussed.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 27222

27090 **Utilization of critical periods during development to study the effects of low levels of environmental agents.** Russell, L.B. (Biology Division, Oak Ridge National Lab., Oak Ridge, TN 37830). pp 143-162 of Measurement of risks. Berg, G.G.; Maillie, H.D. New York, NY; Plenum Publishing Corp. (1981). (CONF-800601—). Contract W-7405-ENG-26.

From 13. Rochester international conference on environmental toxicity--measurement of risks; Rochester, NY, USA (2 Jun 1980).

This chapter shows how careful definition of critical periods in the development of selected characters can result in experimental systems that may be highly useful in studying risk at low levels of exposure. Presents 3 systems that utilize critical periods to study low-level effects: 1) cell kinetics as an indicator of nervous-system maldevelopment; 2) oocyte depletion; and 3) homeotic shifts in the skeleton. Discusses application of the sensitive systems to the testing of chemicals and the role of sensitive stages in estimating risk. Suggests that tests such as the 3 discussed in this paper, which are developed with strict attention to specific critical periods, can provide rapid and sensitive means for revealing whether an agent is capable of causing developmental interference. Concludes that epidemiological investigations can lose much of their value unless critical periods are known for the endpoints being studied.

5303 Environmental Impact Statements

27091 **(DOE/EIS—0005-FS) Bonneville Power Administration proposed fiscal year 1979 program. Facility location supplement. San Juan Islands Area Service, 115-kV submarine transmission cable. Final supplement, final environmental impact statement.** (USDOE Assistant Secretary for Environment, Washington, DC). Jan 1981. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010949.

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A proposal for transmission facilities to serve the San Juan Islands is described. The proposal consists of four subprojects: (1) a 4.5 mile 115-kV submarine cable across Rosario Strait from Fidalgo Substation on Fidalgo Island to the eastern shore of Decatur Island; (2) a 1.5 mile 115-kV underground cable across Decatur Island; (3) a 2.2 mile 115-kV submarine cable across Lopez Sound from the western shore of Decatur Island to the Lopez Substation on the eastern shore of Lopez Island; and (4) replacement of approximately 1000 ft. of double-circuit wood-pole overhead line with two 34.5-kV underground cables on the eastern side of Decatur Island to move the existing terminal structure inland. 34 references, 2 figures.

27092 **(DOE/EIS—0005-FS-2) Bonneville Power Administration proposed fiscal year 1979 program, facility planning supplement Southwest Oregon Area Service. Final environmental impact statement, final supplement.** (USDOE Assistant Secretary for Environment, Washington, DC). Sep 1979. 307p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE84011249.

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This Final Facility Planning Supplement documents the environmental impacts of two electrical plans of service to provide power to southwestern Oregon and reinforce the Pacific Northwest power grid. BPA proposes construction of the following two transmission facilities: (1) a 500-kV line from Idaho Power Company's Brownlee Substation in Idaho to BPA's Slatt Substation near Arlington, Oregon, and (2) a 500-kV line from Buckley (near Maupin, Oregon) to Malin, Oregon. The new 500-kV transmission line would provide backup to the overall system in case of loss of existing lines. This backup would be available for power transfer in the Pacific Northwest as well as into the Idaho region when that system requires reinforcement. The impacts at this planning stage are generalized pertaining to normal construction and maintenance effects. Construction, operation, and maintenance of a transmission line along any of the alternate corridors would have minimal impact on air quality. Impacts to geology, soils, and vegetation, disturbance to wildlife and recreation facilities would occur during construction activities. All options, except the proposed plan of service, required some new right-of-way. Where new right-of-way is required, impacts would be greater.

27093 **(DOE/EIS—0030) Bonneville Power Administration proposed fiscal year 1980 program. Final environmental impact statement.** (USDOE Assistant Secretary for Environment, Washington, DC). Mar 1979. 563p. NTIS, PC A24/MF A01; 1; GPO Dep. Order Number DE84011234.

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This environmental statement describes BPA's proposed program for fiscal year 1980. This proposed program for which BPA is requesting approval consists of the construction of new additions and modifications to its existing transmission system as well as the

continued maintenance of existing facilities during the fiscal year. The proposed program would result in the diversion of approximately 450 acres (182 ha) of forest land to other land uses compatible with transmission line rights-of-way; the permanent removal of all vegetative cover from approximately 67 to 77 acres (27 to 31 ha) as a result of the construction of the new substations and transmission lines; control of all tall woody vegetative species on forest land that would be required for maintenance activities during fiscal year 1980; removal of up to 33 acres (13.3 ha) of cropland from production; vegetative control measures which will reduce vegetative cover on about 19,060 acres (7712 ha) of existing right-of-way and 920 acres (372 ha) of existing substation property; effects both beneficial and adverse on existing wildlife habitat which would occur as a result of construction and maintenance operations as indicated above; impacts to fishery and aquatic organisms as represented by the waterways or tributary streams that would be crossed during construction; visual impacts to recreational resources; introduction of combustion byproducts into the atmosphere as a result of open burning of slash timber from clearing approximately 450 acres (182 ha) of forest land; resultant soil erosion and losses attributable to the clearing, construction, and maintenance activities involved in the proposed program; audible noise during operation of construction equipment and transmission lines and substations; increased risk of man-caused accidents; and maintenance of a high standard of living and level of productivity for the Pacific Northwest through continued availability of reliable electric service.

27094 **(DOE/EIS—0030-FS-1) Bonneville Power Administration proposed fiscal year 1980 program. Facility location supplement, northwest Montana/north Idaho support and Libby integration. Final environmental impact statement, final supplement.** (USDOE Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness, Washington, DC). Aug 1981. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE84011248.

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The proposal involves rebuilding to higher capacity 93 miles (149 km) of transmission line primarily on existing right-of-way. Implementation of the proposal will divert about 48 acres (19 ha) of forest land to other land uses compatible with a transmission line right-of-way; remove 2.6 acres (1.1 ha) of farmland from range and crop production; remove all vegetation from about 11 miles (18 km) of new access roads; cause potential wildlife impacts, beneficial and adverse, as a result of the aforementioned vegetation removal; increase collision hazards to waterfowl and bald eagles; create visual impacts in recreational and residential areas; affect aquatic organisms and vegetation where the line crosses a wetland and streams; introduce small amounts of combustion byproducts into the atmosphere as the result of open burning of slash from clearing and construction activities; create audible noise during operation of construction equipment; maintain the quality and reliability of electrical service to the area; conserve energy by reducing transmission system losses. 104 references, 12 figures, 7 tables.

27095 **(DOE/EIS—0077-FS) Bonneville Power Administration: Crow Butte Slough Crossing. Supplement to final EIS, Ashe-Slatt (Pebble Springs) 500-kV transmission line.** (USDOE Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness, Washington, DC). Apr 1982. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010950.

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The proposed action is to construct a 4700-foot segment of the Ashe-Slatt transmission line at Crow Butte Slough, overhead on towers on the existing right-of-way. Alternatives to the proposal include undergrounding the line on the right-of-way or on an existing causeway off the right-of-way, and no action (removing an existing temporary overhead line). The proposed action will result in: temporary disruption (along the right-of-way) and/or destruction (at tower sites) of the habitat, including a wetlands area, and localized noise during construction; both direct (aesthetic) and indirect (recreational) visual effects of the towers and lines, some waterfowl mortality from in-flight collisions, possible corona noise or electric/magnetic effects on some animals, and vegetative control by minor herbicide use during operation. Underground alternatives on the right-of-way cause greater temporary disruption and/or destruction of the habitat, temporary deterioration of the water quality, and possible interference with access to the Crow Butte State Park during construction; terminal station visibility, and possible impacts from accidental chemical (dielectric fluid) releases, from minor uses of herbicides, from cable heat on revegetation, or from cooling station noise to animals during operation. The underground alternatives off the right-of-way avoid the wetlands area and have less effect on aquatic elements, but are considerably more disruptive to Park access. The no-action alternative jeopardizes service in the Willamette Valley, a rapidly growing area in western Oregon. While the impacts differ for the proposed action and the different alternatives, and while the proposed action is not environmentally preferred, the overall impact of any of the action options is not significant or sufficient to preclude selection on an environmental basis. The economic advantage of the proposed action is considerable. 1 figure.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

27096 **(NP—4770238) GBF scientific report 1982.** (Gesellschaft fuer Biotechnologische Forschung m.b.H., Braunschweig (Germany, F.R.)). 1983. 174p. (In German). Gesellschaft fuer Biotechnologische Forschung m.b.H., Braunschweig, Germany, F.R.

The Scientific Report 1982 of the GBF (Gesellschaft fuer Biotechnological Forschung mbH) reveals that research work continuos to be focussed on the search for, and preparation of substances for the fields of pharmacy and medicine. Results achieved were communicated in over 170 publications and some 150 lectures and a number of processes and substances have been patented. Cooperation has continued with a number of firms and questions of common interest tackled; contracts have been concluded with some companies for the scale of know-how or licences, especially on the preparation of enzymes and substances of use in gene technology. Greatest progress was achieved in the fields of cell culture techniques/cell biology, gene technology and enzyme technology.

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 27188

27097 (CONF-811048—Summs., pp 4p, Paper 1) **Olfactory and chemical characterization of indoor air - towards a psychophysical model for air quality.** Berglund, B.; Berglund, U.; Lindvall, T.; Nicander-Bredberg, H. (Univ. of Stockholm, Sweden). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The odor strength of the total air samples was obtained with the aid of observers. These odor strength values were compared with different statistical measures obtained from the perceptio-olfactorygrams (POG) of corresponding samples. In line with our earlier research, some simple models of odor summation were tried. These were: (a) strongest POG value, (b) mean POG value, (c) frequency of odorous components detected by FID, (d) mean POG value of those FID-detected components that most frequently were reported to have a strong odor, and (e) frequency of the FID-detected components that were most frequently reported to have a strong odor. A liner regression analysis was performed on 88 air samples and a Pearson correlation coefficient of .73 was obtained for model (e) above. The next highest correlation (.25) was obtained for model (c) and all the other correlations fell close to zero. (DT)

27098 **Transport of oyster larvae in an estuary.** Seliger, H.H.; Boggs, J.A.; Rivkin, R.B.; Biggley, W.H.; Aspden, K.R.H. (Johns Hopkins Univ., Baltimore, MD). *Marine Biology (Berlin);* 71: 57-72(1982). Contract AC02-76EV03278.

Vertical and horizontal distributions of 3 larval stages of the oyster Crassostrea virginica were measured concurrently with phytoplankton species compositions, phytoplankton size distributions and physical hydrographic parameters in tributaries of the Chesapeake Bay (USA) during the oyster spawning seasons of 1980 and 1981. The superposition of the biological distributions upon the physical hydrographic data provide instantaneous distributions of

the entire system which are consistent with upstream transport of oyster larvae. Oyster larvae distributions in the Choptank River and its Broad Creek and Tred Avon River tributaries can be described in terms of three contiguous regions: a common spawning region; an intermediate, upstream transport region; and a seed bed region where major spat set occurs. The phytoplankton species compositions and abundances in the size fraction less than 10μm in the tributary system during the transport were sufficient to supply optimum growth requirements of developing larvae. The transport proposed can explain the 30 yr record of consistently higher spat set success in one tributary, the Tred Avon River. This may be a general mechanism whereby oysters maintain reproductive success and emigrate to seed bed regions in the Chesapeake Bay.

27099 **Continuous migration model with stable demography.** Sawyer, S. (Purdue Univ., West Lafayette, IN); Felsenstein, J. *Journal of Mathematical Biology;* **11**: 193-205(1981). Contract AT06-76EV71005;AM06-76RL02225.

A probability model of population undergoing migration, mutation, and mating in a geographic continuum R is constructed, and an integro-differential equation is derived for the probability of genetic identity. The equation is solved in one case, and asymptotic analysis done in others. Individuals at x, yεR in the model mate with probability V(x,y)dt in any time interval (t,t+dt). In two dimensions, if V(x,y) = V(x-y) where V(x) ≈ V(x/β)/β² approaches a delta function, the equilibrium probability of identity vanishes as β→0. The asymptotic rate at which this occurs is discussed for mutation rates u identical with $u_0 > 0$ and for β ≈ Cu/sup alpha/, α > 0, and u → 0.

5502 Biochemistry

REFER ALSO TO CITATION(S) 25596, 25636, 26566

27100 (CONF-811048—Summs., pp 4p, Paper 70) **Estimation of personal exposure to carbon monoxide from fixed and portable monitoring.** Atherton, M.J. (Frank E. Basil, Inc., Columbia, MD). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Carbon monoxide levels in excess of 200 ppM have been observed in urban highways during rush hour traffic and several occupational groups (i.e., garage attendants, traffic officers, cab drivers) have incurred markedly elevated COHb levels from work-related exposures sustained in urban traffic. Thus the selection and field use of accurate exposure monitoring techniques have become a singularly important issue whose resolution will hopefully advance new knowledge of pollution control efficacy. This report examines monitoring techniques in current use by comparing human exposures to CO derived from portable monitors, fixed-site monitors, and alveolar breath samples. (DT)

27101 (LBL—13500, pp 2.16-2.20) **Energy conversion by the retinal protein, bacteriorhodopsin.** Packer, L.; Quintanilha, A.T.; Mehlhorn, R.J.; Fry, I.; Herz, J.; Lam, E.; Tristam-Nagle, S. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Bacteriohodopsin is found in the cell membranes of certain salt-requiring bacteria including Halobacterium halobium. Our research program is attempting to determine the molecular details of how this protein utilizes light from the sun to produce an electrical current across the bacterial membranes.

27102 **(SSRL—84/02) X-ray absorption spectroscopy of hemocyanin and hemerythrin.** Co, M.S. (Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.). May 1983. Contract AC03-76SF00515. 202p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010930.

Portions are illegible in microfiche products; Thesis.

The oxygen binding site of hemocyanin has two copper atoms coordinated to the side chains from the polypeptide chain. Copper extended x-ray absorption fine structure (EXAFS) and absorption edges of the protein were studied. Comparison of EXAFS from three molluscan oxyhemocyanins (Megathura crenulata, the α/sub c/ and β/sub c/ of Helix pomatia) indicates that the structure of the binuclear copper sites is very similar in the three proteins. Four different forms (oxy, deoxy, dimer, and half-apo) of hemocyanin from M. crenulata were selected for a detailed study. A structural model of the oxygen binding site is proposed based on the EXAFS results. The oxygen binding site in hemerythrin contains two iron atoms coordinated to the side chains from the polypeptide chain. Iron EXAFS and absorption edges from Phascolopsis gouldii hemerythrin were studied. Five different forms (oxy, deoxy, aquomet, hydroxomet, and azidomet) of the protein were selected for this study. A structural model of the oxygen binding site in hemerythrin is proposed.

27103 **Reconstitution of the membrane-bound, ubiquinone-dependent pyruvate oxidase respiratory chain of Escherichia coli with the cytochrome d terminal oxidase.** Koland, J.G.; Miller, M.J.; Gennis, R.B. (Univ. of Illinois, Urbana). *Biochemistry;* **23**: No. 3, 445-453(31 Jan 1984). Contract AC02-80ER10682.

Pyruvate oxidase is a flavoprotein dehydrogenase located on the inner surface of the Escherichia coli cytoplasmic membrane and coupled to the E. coli aerobic respiratory chain. The role of quinones in the pyruvate oxidase system is investigated, and a minimal respiratory chain is described consisting of only two pure proteins plus ubiquinone 8 incorporated in phospholipid vesicles. The enzymes used in this reconstitution are the flavorprotein and the recently purified E. coli cytochrome d terminal oxidase. The catalytic velocity of the reconstituted liposome system is about 30% of that observed when the flavoprotein is reconstituted with E. coli membranes. It is also shown that electron transport from pyruvate to oxygen in the liposome system generates a transmembrane potential of at least 180 mV (negative inside), which is sensitive to the uncouplers carbonyl cyanide p-(trichloromethoxy)phenylhydrazone and valinomycin. A transmembrane potential is also generated by the oxidation of ubiquinol 1 by the terminal oxidase in the absence of the flavoprotein. It is concluded that: the flavoprotein can directly reduce ubiquinone 8 within the phospholipid bilayer; menaquinone 8 will not effectively substitute for ubiquinone 8 in this electron-transfer chain; and the cytochrome d terminal oxidase functions as a ubiquinol 8 oxidase and serves as a coupling site in the E. coli aerobic respiratory chain. These investigations suggest a relatively simple organization for the E. coli respiratory chain.

27104 **Comparison of the mechanism of cellulose biosynthesis in plants and bacteria.** Delmer, D.P. (Michigan State Univ., East Lansing); Benziman, M.; Klein, A.S.; Bacic, A.; Mitchell, B.; Weinhouse, H.; Aloni, Y.; Callaghan, T. *Journal of Applied Polymer Science: Applied Polymer Symposium;* 1-16(1983). (CONF-8205234—Vol.1). Contract AC02-76ER01338.

From 9. cellulose conference; Syracuse, NY, USA (24 May 1982).

Results of recent studies on the mechanism of cellulose biosynthesis in higher plants and in the bacterium Acetobacter xylinum are compared and contrasted. In higher plants, the synthesizing complex is thought to be mobile in the fluid-mosaic plasma membrane, whereas it is stationary in cells of A. xylinum. Similar patterns of sensitivity to inhibitors of cellulose synthesis as well as to changes in transmembrane electrical potential are shared by both plants and A. xylinum. In vivo tracer studies with both types of organisms support the concept the UDP-glucose is a precursor of cellulose. A characterization of additional compounds which may serve as precursors in A. xylinum beyond the level of UDP-glucose is described. UDP-glucose:β-glucan synthetases have been solubilized from plants and A. xylinum. Attempts at purification of solubilized soybean glucan synthetases indicate that a factor(s) is lost during purification which is necessary for activity; studies described elsewhere indicate that the A. xylinum β-1,4-glucan synthetase requires a protein factor for GTP activation. The stimulatory effect of polyethylene glycol (PEG) on glucan synthetases from both plants and A. xylinum may relate to stabilization by PEG of enzyme-factor associations. 34 references, 3 figures, 3 tables.

27105 **Inhibition of DNA synthesis, independent of DNA adduct formation, by benzo[a]pyrene diol epoxide in mammalian cells.** Lockhart, M.L.; Rosenberg, B.H. (Sloan-Kettering Inst. for Cancer Research, Rye, NY). *Carcinogenesis (New York);* **4**: No. 2, 125-130(1983).

Treatment of SV40-infected CV-1 cells with the ultimate carcinogen anti-benzo[a]pyrene diol epoxide (BPDE) at 1 x 10^{-4} mg/ml or higher reduced the rate of viral DNA synthesis to an extent dependent on the BPDE concentration; similar reductions in cellular DNA synthesis were produced in infected and uninfected cells. Treatment of cells with BPDE, followed by removal of BPDE, at various times before infection with SV40 gave the same results. Recovery or partial recovery of DNA synthesis occurred when the BPDE concentration was below 6 x 10^{-4} mg/ml; at higher concentrations the cells were killed. Simultaneously replicating viral DNA's from viruses infecting the same cells before and after BPDE treatment of the cells exhibited the same reduced rate of synthesis. The evidence indicates that covalent adducts in viral DNA are not responsible for its reduced replication rate; moreover, it is probable that an insignificant number of adducts is produced in intracellular viral DNA at BPDE concentrations that do not kill CV-1 cells. Rather, it appears likely that BPDE inhibits viral DNA synthesis by attacking cellular DNA or non-DNA targets. Caution is therefore required in relating the effects of BPDE and other carcinogens to DNA adduct formation.

27106 **Poliovirus RNA synthesis in vitro: structural elements and antibody inhibition.** Semler, B.L.; Hanecak, R.; Dorner, L.F.; Anderson, C.W.; Wimmer, E. (State Univ. of New York, Stony Brook). *Virology;* **126**: 624-635(1983).

The poliovirus RNA polymerase complex has been analyzed by immunoautoradiography using antibody probes derived from purified replicase (P3) region viral polypeptides. Antibody preparations made against the polio RNA polymerase, P3-4b, detected a previously unreported cellular protein that copurifies with the RNA polymerase. An IgG fraction purified from rabbit antiserum to polypeptide P3-2, a precursor fo the RNA polymerase, specifically inhibits poliovirus RNA synthesis in vitro. The authors have also immunoprecipitated a 60,000-dalton protein (P3-4a) with antiserum to protein P3-4b and have determined the precise genomic map position of this protein by automated Edman degradation. Protein P3-4a originates by cleavage of the RNA polymerase precursor at a glutamine-glucine amino acid pair not previously reported to be a viral cleavage site.

27107 **Generation and characterization of aerosols of dispersed surface active phospholipids by ultrasonic and jet nebulization.** Marks, L.B.; Oberdoerster, G.; Notter, R.H. (Univ. of Rochester School of Medicine, NY). *Journal of Aerosol Science;* **14**: No. 5, 683-694(1983). Contract AC02-76EV03490.

The aerosolization of a multicomponent lipid mixture extracted from bovine lung lavage was investigated in terms of the humidity dependence of the particle size distribution produced by both an ultrasonic and a jet nebulizer. Two methods, sonication on ice and mechanical vortexing, were used to disperse the lipid mixture in 0.15 M NaCl prior to aerosolization in each nebulizer. For both dispersion methods, the particle size dependence on humidity was affected by the presence of dispersed lipids (concentration ~ 1.5mg/ml) compared to the case of 0.15 M NaCl aerosols without surfactants. The aerosol from the jet nebulizer consisted of dry particles, and the typical deliquescent behavior for NaCl particles could be demonstrated when relative humidity was increased above 70%. However, when the lipid mixture was nebulized, no such particle growth was observed up to 95% relative humidity. The emerging aerosol from the ultrasonic nebulizer consisted of droplets due to high humidity. In the case of NaCl, these droplets evaporated and became smaller in size with decreasing humidity. For the lipid-saline mixture, the droplets were much more stable and started to evaporate only below 60-70% relative humidity Although both ultrasonic and jet nebulizers gave particle size distributions in the range for significant alveolar deposition (0.4-1.5 μm AMAD), the ultrasonic nebulizer aerosol sizes at high humidity were optional in this respect. Calculations of lipid surface and bulk concentration suggest that a significant part of the observed phospholipid dispersion effects on aerosol behavior may be related to bulk phase interactions.

27108 **Comparison of the kinetics fo ribooligonucleotide, deoxyribooligonucleotide, and hybrid oligonucleotide double-strand formation by temperature-jump kinetics.** 473194elson, J.W.; Tinoco, I. Jr. (Univ. of California, Berkeley). *Biochemistry;* **21**: 5289-5295(1982). Contract AC03-76SF00098.

The kinetics of double-strand formation were measured by using temperature-jump kinetic techniques for the DNA oligonucleotides $dCA_5G + dCT_5G$, the analogous RNA oligonucleotides $rCA_5G + rCU_5G$, and the hybrid $rCA_5G + dCT_5G$. The DNA oligonucleotides have a faster rate of recombination and a slower rate of dissociation at 12.0°C than the RNA oligonucleotides; the hybrid has about the same recombination rate and a slightly faster dissociation rate than the RNA oligonucleotides. The activation energies for recombination of the DNA and RNA oligonucleotides are both near 0 kcal/mol. The difference in dissociation and recombination activation energies is consistent with the thermodynamic results obtained earlier. The relaxation process is composed of two exponential components for the RNA and hybrid oligonucleotides at temperatures of 12.0°C and lower. One exponential component is observed for these oligonucleotides above 12.0°C and for the DNA oligonucleotides at all temperatures.

5503 Cytology

REFER ALSO TO CITATION(S) 27145, 27174, 27175

27109 (CONF-811048—Summs., pp 4p, Paper 19) **Measurements of radon daughters in 5 600 Swedish homes.** Hildingson, O. (Swedish National Testing Inst., Boras). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

In the beginning of the research it was estimated that 15,000 dwellings out of all buildings built of lightweight concrete with high radiumcontnet in Sweden would have a radon daughter concentration above 400 Bq/m^3. Extrapolating from our results sofar the number would be 50,000. One fifth of these dwellings would have radon daughter concentration abote 1000 Bq/m^3. these houses have to be rebuilt within two years according to the Swedish Building Code. The number will be still higher if radon exhalation from the ground is taken into account. This report describes the first 5600 measurements. Up to summer 1982 probably 15,000 dwellings will have been measured. so far we have found that radon from ground has more influence than we thought in the beginning. Currently research is made to investigate radonexhalation from building materials and ground, and to investigate different measures to decrease the Rnd concentration indoor. (DT)

27110 (CONF-811048—Summs., pp 4p, Paper 53) **Correlations between lung cancer and phosphates.** Fleischer, R.L. (General Electric Research and Development Center, Schenectady, NY). 1981. NTIS, PC A13/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The question raised here is whether elevated radon emission associated with the mining or processing or uranium-rich material could lead to increases in the incidence of lung cancer. For example, phosphate mining is a major industry (52.10^9 kG in the United States in 1977) and the deposits plus their mining and milling involve large amounts of uranium, radium, and radon, and associated radiochemical pollution including the release of ^{222}Rn. The amount of uranium contained in the annual production of processed phosphate rock is approximately equal to that mined as uranium ore. Both phosphates and uranium have been examined in this study. (DT)

27111 **Method and apparatus for fringe-scanning chromosome analysis.** Norgren, R.M.; Gray, J.W.; Hirschfeld, T.B. (to Dept. of Energy). US Patent Application 6-528,284. 31 Aug 1983. 26p. Contract W-7405-ENG-48.

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Apparatus and method are provided for analyzing submicron-sized features of microscopic particles. Two central features of the invention are (1) constraining microscopic particles to flow with substantially constant orientation through a predetermined in-

terference fringe pattern, and (2) estimating particle structure by analyzing its fringe profile. The invention allows nearly an order of magnitude higher resolution of chromosome structure than possible with currently available flow system techniques. The invention allows rapid and accurate flow karyotyping of chromosomes.

27112 **Hypersensitivity to cell killing and mutation induction by chemical carcinogens in an excision repair-deficient mutant of CHO cells.** Thompson, L.H.; Salazar, E.P.; Brookman, K.W.; Hoy, C.A. (Lawrence Livermore National Lab., CA). *Mutation Research;* **112**: 329-344(1983). Contract W-7405-ENG-48.

A strain of Chinese hamster ovary cells that is deficient in nucleotide excision repair, strain UV5, was compared with the normal parental CHO cells in terms of cytotoxicity and mutagenesis after exposure to several chemical carcinogens that are known to produce bulky, covalent adducts in DNA. Induced mutations were measured at the hprt locus using thioguanine resistance and at the aprt locus using azaadenine resistance. The compounds tested that required metabolic activation (using rate or hamster microsomal fractions) were 7,12-dimethylbenz(a)anthracene, 3-methylcholanthrene, benzo(a)pyrene, aflatoxin B1, 2-acetylaminofluorene, and 2-naphylamine. The direct-acting compounds (+/-)-r-7,t-8-dihydroxy-t-9,10-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene, N-acetoxy-2-acetylaminofluorene, and N-OH-2-naphththylamine were also studied. For all compounds except 2-napthylamine and its active metabolite, the repair-deficient cells were significantly more sensitive to killing than the normal CHO cells. Mutation induction at both loci was also more efficient in UV5 cells in each instance where enhanced cytotoxicity was observed. By using tritium-labeled N-acetoxy-2-acetylaminoflourene, normal and mutant cells were shown to bind mutagen to their nuclear DNA with similar efficiency, and a greater amount of adduct removal occurred in the normal cells. From this study it is concluded that the use of excision repair-deficient CHO cells provides enhanced sensitivity for detecting mutagenesis and that a positive differential cytotoxicity response gives an indication of repairable, potentially lethal genetic damage.

27113 **Induction of sister chromatid exchanges by 5-fluorodeoxycytidine: correlation with DNA methylation.** Chambers, J.C.; Taylor, J.H. (Florida State Univ., Tallahassee). *Chromosoma;* **85**: 603-609(1982). Contract AS05-78EV05854.

Chinese hamster ovary cells grown in medium containing 10 μM 5-fluorodeoxycytidine for forty-eight hours were found to have up to 5% of the deoxycytidine residues of the DNA substituted by this analog. Cytological studies of these cells showed that the incorporated 5-FdC caused a two-fold increase of sister chromatid exchanges (SCE) over the control level. However, 5-FdC was capable of inducing SCE only after it had been present in the cell for at least two cycles of DNA synthesis. This is in contrast to several other chemicals that were tested which induced SCE immediately after the first DNA synthesis. The authors consider the possibility that the delayed effect may be related to hypomethylation of cytosine in the newly replicated DNA.

27114 **Cell volumes, maximal growth rates of unicellular algae and ciliates, and the role of ciliates in the marine pelagial.** Banse, K. (Univ. of Washington, Seattle). *Limnology and Oceanography;* **27**: No. 6, 1059-1071(1982). Contract AT06-76EV75026.

A review of growth rates of diatoms and dinoflagellates in light-saturated, nutrient-replete cultures at 20°C confirms weak dependence on cell volume or mass. These maximal (intrinsic) rates are not linearly related to surface area or surface-to-volume ratio of the cells. The growth of most diatoms is materially faster than that of dinoflagellates; other algae fall in between or below the dinoflagellates. Small ciliates have appreciably higher intrinsic growth rates than algae of the same cell volume. The average food consumption per ciliate in the marine pelagic realm is inferred to be very low, so that the realized specific growth rates are much smaller than the intrinsic potentials. Also, a previously postulated refuge from predation, afforded by small size, is extended down to about 10-μm^3 cell volume.

27115 **Laboratory determined mortality, fecundity and growth rates of Thalia democratica Forskal and Dolioletta gegenbauri Uljanin (Tunicata, Thaliacea).** Deibel, D. (Skidaway Inst. of Oceanography, Savannah, GA). *Journal of Plankton Research;* **4**: No. 1, 143-153(1982). Contract AS09-76EV00936.

Laboratory experiments are reported which provide information on culture conditions, mortality, fecundity and growth of Thalia democratica and Dolioletta gegenbauri in relation to simulated environmental conditions. Thaliacenas were maintained in laboratory culture at 20°C. Culture vessels were 2.5 l glass bottles. Diets consisted of Isochrysis galbana and Peridinium trochoideum, offered alone or together at total concentrations of 0.25 to 0.70 $mm^3 \times l^{-1}$. Laboratory released aggregate stages of Thalia were maintained for one week and gonozooid, phorozooid and oozooid stages of Dolioletta were reared for up to three weeks with daily mortality rates of 5-10%. There was no effect of diet on mortality rate. Thalia did not reproduce sexually but Dolioletta did routinely. Each Thalia solitary relased a mean (+/- SE) of 54 +/- 8 aggregates of 1.1-2.1 mm length. Each Dolioletta gonozooid produced 2-6 larvae 0.6-1.2 mm long, and each phorozooid released a mean of 31 +/- 11 gonozooids. Aggregate growth was exponential for 7 days, with daily exponential growth coefficients (k) ranging from 0.03-0.36. Gonozooids grew exponentially for 17 days with a range of k from 0.08-0.25, and phorozooids grew exponentially for 5 days with k ranging from 0.17-0.69. There was no effect of food concentration on k. Generation times of Thalia and Dolioletta were estimated to be from 3-6 weeks. These are probably maximum generation times for these two species in the Georgia Bight.

27116 **Light-shade adaptation by the oceanic dinoflagellates pyrocystis noctiluca and P. fusiformis.** Rivkin, R.B.; Seliger, H.H.; Swift, E.; Biggley, W.H. (Johns Hopkins Univ., Baltimore, MD). *Marine Biology (Berlin);* **68**: 181-191(1982). Contract AC02-76EV03278.

Species-specific rates of photosynthetic carbon uptake (P), chlorophyll a content and P versus irradiance (P-I), have been measured for cells of Pyrocystis noctiluca and P. fusiformis collected in the Sargasso Sea. These same measurements and the assay for ribulose bis-phosphate carboxylase (RuBP-Case), have been made for cultures of P. noctiluca in a 12 h L:12 h D photoperiod at 9 different constant or at changing light intensities. The photosynthetic capacity (P/sub max/), of cells captured below the surface mixed layer was lower by a factor of 10 compared with cells collected from the surface mixed layer. The P/sub max/ for P. noctiluca collected and incubated within the surface mixed layer was the same as for cell cultures grown under high light, non nutrient-limiting conditions. In laboratory cultures under constant low light intensities, chl a $cell^{-1}$ increased by a factor of 5 while both p/sub max and RuBPCase activity decreased by a factor of ca 4 compared with high light intensities. For all irradiance conditions in culture, the P-I dependence could be described by the simple Michaelis-Menten formula. The ratio of P/sub max/ to K_1, (the light intensity where P=P/sub max//2) was a constant with a Coefficient of Variation of 12%: the constancy of this ratio, the parallel changes in RuBPCase activity with P/sub max/ and the constant chl a $cell^{-1}$ in the Sargasso Sea imply that for P. noctiluca and presumably P. fusiformis in nature, a dark enzymatic step rather than changes in photosynthetic pigment concentrations may regulate the photosynthetic capacity in the changing photic environment.

5504 Genetics

REFER ALSO TO CITATION(S) 27105, 27108, 27112, 27113

27117 **(DOE/EV/01300—48) Analysis by transposable element mutagenesis of tissue-specific R alleles in maize.** (Wisconsin Univ., Madison (USA)). Apr 1984. Contract AC02-76EV01300. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010929.

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Transposition of the mobile sequence Dissociation to an R allele which confers seed but not plant color (Sc) destabilizes expression giving spotted kernels. Removal of the corresponding regulator from the genome immobilizes Ds at R. The resulting (Sc)Ds

derivatives are colorless or pale seeded and stable as homozygotes. Strong seed color is rescued through recombination in heterozygotes of (Sc)Ds with an allele which confers only plant color, (P). Such crossovers provide a means of (1) mapping the position of Ds insertions within (Sc) relative to the site which distinguishes (Sc) from (P) action, and (2) systematically mutagenizing (P) and other such R elements by transferring Ds from (Sc) to homologous sites by recombination.

27118 **Application of restriction fragment length polymorphism to plant breeding.** Burr, B. (Brookhaven National Lab., Upton, NY); Evola, S.V.; Burr, F.A.; Beckmann, J.S. pp 45-59 of Genetic engineering: principles and methods. Vol.5. Setlow, J.K.; Hollaender, A. (eds.). New York, NY; Plenum Publishing Corporation (1983).

Restriction fragment length polymorphism (RFLP) is discussed in relation to its possible uses in agronomic improvement. It is shown that it is possible to construct genetic maps based on RFLPs in a number of crop plants. Experimental studies have found RFLPs are prevalent in maize. Six common maize inbreds whose DNA had been digested with two enzymes were examined and five alleles were found among them. It was then determined whether random DNA clones could detect the same degree of heterogeneity. Most of the zein clones hybridized to numerous restriction fragments. However, seven tested zein clones and all non-zein clones but one hybridized to one to three major bands. In maize as well as other crop plants RFLP markers should prove useful to plant breeders. Problems in plant breeding are discussed where molecular analytic techniques might increase the efficiency of the practitioner.

27119 **Dissection of a replication origin of Xenopus DNA.** Chambers, J.C.; Watanabe, S.; Taylor, J.H. (Florida State Univ., Tallahassee). *Proceedings of the National Academy of Sciences of the United States of America;* **79**: 5572-5576(Sep 1982).

A previously cloned 503-base pair (bp) EcoRI segment of genomic DNA from Xenopus laevis selected for enhancement of replication of its vector plasmid was moved to the EcoRI site of pBR322. This plasmid designated pJCC31 and five other clones, which were made by cleaving the 503-bp segment in relation to a dispersed repeated sequence and subcloning, were compared with pBR322 for replication by microinjection into Xenopus eggs. The replication measured by incorporation of a ^{32}P-labeled nucleotide as well as semiconservative segregation and dilution of N^6-methyladenine at the EcoRI sites showed pJCC31 to be about 15 times as efficient as pBR322. The next most efficient subclone, pJCC31-2, contains an insert with a complete 320-bp dispersed repeated sequence bracketed by an 8-bp direct repeat. This observation, along with the authors' previous report that repeated sequences of the Alu family in the human genome enhanced replication of the vector plasmid nearly as much as that of the presumptive Xenopus origin, leads to the hypothesis that members of a subset of the short dispersed repeated sequences in vertebrates function as origins for chromosomal replication. Preliminary studies also show that the presumptive Xenopus origin contains a RNA polymerase promoter that increases the transcription of the plasmid when it is microinjected into Xenopus oocytes.

5505 Metabolism

REFER ALSO TO CITATION(S) 25595, 25597, 27128, 27130

27120 **(PNL-SA—12069) Clinical-pathological correlations in neoplasia.** Weller, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 123p. (CONF-8404134—1). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010700.

From Veterinary Post-Graduate Institute seminar; Santa Cruz, CA, USA (27 Apr 1984).

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Hypercalcemia can cause serious morbidity and mortality among animals suffering from cancer. Cancer-associated hypercalcemia (pseudohyperparathyroidism, malignant hypercalcemia) in domestic animals is reviewed and described. It is the most common cause of elevated total serum calcium in veterinary medicine. The clinical signs and laboratory findings associated with several neoplasms are discussed, as well as the possible pathophysiologic pathways and substances by which those neoplasms cause osteoclastic skeletal resorption.

27121 **Bioelimination of ^{51}Cr and ^{85}Sr by cockroaches, Gromphadorhina portentosa (orthoptera: blaberidae), as affected by mites, Gromphadorholaelaps schaeferi (parasitiformes: laelapidae).** Schowalter, T.D.; Crossley, D.A. Jr. (Univ. of Georgia, Athens). *Annals of the Entomological Society of America;* **75**: No. 2, 158-160(Mar 1982). Contract AS09-76EV00641.

The rates of Chromium-51 and Strontium-85 assimilation and bioelimination by the hissing cockroach, Gromphadorhina portentosa (Schaum) are described when the symbiotic mite, Gromphadorholaelaps schaeferi Till, was present or removed. Mite-infested cockroaches had significantly higher rates of ^{51}Cr elimination relative to mite-free cockroaches, implying more rapid gut clearance times. The authors did not find a significant mite effect on ^{85}Sr elimination by the host, but mite effects could have been masked by the apparently unique process of nutrient assimilation and elimination by G. portentosa. Conventional models of radioactive tracer bioelimination predict a rapid initial loss of tracer due to gut clearance, followed by a slower loss due to excretion of assimilated tracer. The results indicated that assimilated ^{85}Sr was eliminated earlier than unassimilated ^{85}Sr, which was lost by defecation.

27122 **Digestive carbohydrase activities in individual marine copepods.** Hassett, R.P.; Landry, M.R. (Univ. of Washington, Seattle). *Marine Biology Letters;* **3**: 211-221(1982).

A digestive enzyme assay is presented that is applicable to small sample sizes, on the order of individual Calanus pacificus Brodsky. Responses to time and enzyme concentration were linear under the specified conditions. Assays of individual copepods revealed a high coefficient of variation for all three enzymes, indicating the potential for large variability in field samples. 90-95% of the variability was attributable to differences among animals. The digestive carbohydrases appear to be responding collectively, but it remains for controlled experiments to determine the extent of this relationship.

27123 **Nitrogen regeneration by the subtropical marine copepod.** Gardner, W.S.; Paffenhoefer, G.A. (Great Lakes Environmental Research Lab., Ann Arbor, MI). *Journal of Plankton Research;* **4**: No. 3, 725-733(1982). Contract AS09-76EV00936.

Ammonium release rates by individual marine copepods (Eucalanus pileatus) were examined kinetically over successive 10-min intervals after the animals were exposed to three concentrations of the diatom Thalassiosira fluviatilis as food. Food concentrations spanned those expected in the natural environment. Well-fed (3 mm^3 T. fluviatilis l^{-1}) copepods released ammonium significantly ($p<0.05$) faster than those fed zero or low concentrations of food, but differences were not dramatic. Mean excretion rates (+/- SE) for animals removed from food for 18-22 h [30 +/- 6 nmol NH_4 (mg ash free dry weight)$^{-1}$ h^{-1}] were ~60% of those for well-fed animals [49 +/-8 nmol NH_4 (mg ash free dry weight)$^{-1}$ h^{-1}. Continued high release rates after extended periods without food suggest that E. pileatus must feed frequently in nature to maintain an adequate nitrogen balance. Depending on food concentration, animals released ammonium at rates ranging from 40 to > 100% of their N ingestion rates over the previous 18-22 h. Long-term (4-6 h) kinetic excretion experiments with well-fed animals indicated that, on average, release rates decreased with time after food removal, but patterns varied among individual copepods. In addition to ammonium release, o-phthalaldehyde reactive amino acid nitrogen was occasionally released by E. pileatus in large spurt events lasting from 20 to 60 min.

27124 **Impact of copepod grazing on the phytoplankton of Georges Bank and the New York Bight.** Dagg, M.J. (Brookhaven National Lab., Upton, NY); Turner, J.T. *Canadian Journal of Fisheries and Aquatic Science;* **39**: No. 7, 979-990(1982). Contract AC02-76CH00016.

The grazing rate of the copepod community was calculated at 10-km intervals on transects of the continental shelf south of Long Island, New York, and across Georges Bank during April, July, and October 1978. During the spring when Calanus and Pseudocalanus dominated, grazing tended to be greatest on the outer shelf and slope regions, and community ingestion rates never exceeded primary production rates; much of the spring bloom was not grazed. During the fall when Centropages and Oithona dominated, grazing was greatest in the shallower regions, and community ingestion rates were often equivalent to or slightly greater than primary production rates. About 50% of the annual primary production was grazed by the copepod community in both regions.

27125 **Laboratory-measured grazing and ingestion rates of the salp, Thalia democratica Forskal, and the doliolid, Dolioletta gegenbauri Uljanin (Tunicata, Thaliacea).** Deibel, D. (Skidaway Inst. of Oceanography, Savannah, GA). *Journal of Plankton Research;* **4**: No. 2, 189-200(1982). Contract AS09-76EV00936.

Grazing and ingestion rates of laboratory-born Thalia democratica aggregates and Dolioletta gegenbauri gonozooids, phorozooids and oozooids were determined while fed Isochrysis galbana (4-5 μm diameter) alone or in combination with Peridinium trochoideum (16-18 μm diameter) at concentrations of 0.15-0.70 $mm^3 \times l^{-1}$. Grazing rates (ml x $zooid^{-1}$ x 24 h^{-1}) ranged from 10 to 355, and at zooid weights greater than 5μg carbon were in order oozooid > gonozooid > aggregate. Grazing rates increased exponentially with increasing zooid weight. Weight-specific grazing rates (ml x μgC^{-1} x 24 h^{-1}) were independent of the four-fold initial food concentration. Mean weight-specific grazing rates increased linearly with increasing zooid weight for the aggregates and oozooids, but gonozooid mean rates were independent of zooid weight. Aggregate and gonozooid ingestion rates ($10^6 \mu m^3$ x $zooid^{-1}$ x 24 h^{-1}) ranged from 4 to 134 while oozooid rates ranged from 3 to 67. All ingestion rates were independent of the initial food concentration but increased linearly with increasing zooid weight at similar rates. All mean weight-specific ingestion rates (ml x μgC^{-1} x 24 h^{-1}) were independent of zooid weight. The mean aggregate daily ration (μgC ingested x μg body C^{-1}) was 59% and the mean doliolid ration was 132%. Field studies indicate that normal concentrations of D. gegenbauri in the Georgia Bight clear their resident water volume (1 m^3) in about 4 months, but that highly concentrated, swarm populations which occur along thermohaline fronts clear their resident water volume in less than 1 day.

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REFER ALSO TO CITATION(S) 26563, 26564, 27227

27126 **(AAEC/E—565) Technetium-99 levels in pertechnetate solutions from (n,γ) and (n,f) molybdenum-99 generators.** Moore, P.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1983. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700938.

There is increasing evidence that, in some radiopharmaceutical kits, Tc-99 has an adverse effect on the imaging and labelling performance of Tc-99m. For example, labelling efficiency with red blood cells can be affected when 99/99m ratios exceed about 4:1. The 99/99m ratio in a target is about 13.5:1 after a seven-day irradiation in a nuclear reactor. The ratio increases slightly during the time needed for processing. With the chromatographic generators used in hospitals, up to 90 hours may elapse between the final wash stage of manufacture and the first elution, during which time, 99/99m ratios can increase to about 90:1. If elution efficiencies are high and the time between elutions is between 12 and 24 hours, ratios in the generator, hence in the eluates, may actually increase with each elution. In the case of ready-to-inject pertechnetate solutions, the critical time at which 99/99m ratios increase rapidly is the time between elution and use. If production conditions are poor, ratios may increase to more than 600:1 by the time of use. With better conditions and production schedules Tc-99 levels at the time of use are comparable to those from chromatographic generators.

27127 **(ARL/TR—057) Derivation and use of nomograms in diagnostic radiography.** Veitch, S.; Young, B. (Australian Radiation Lab., Melbourne). Jul 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700937.

The accuracy and use of nomographic techniques as a means of estimating the absorbed dose given to the skin of patients undergoing radiographic examinations is discussed for both single-phase and three-phase X-ray generating equipment. A comparison has also been made with previously published data for single-phase equipment.

27128 **(BNL—34523) Radiotracers in PETT: strategies for in vivo receptor activity, Schizophernia, and Alzheimer's Dementia studies.** Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 3p. (CONF-8406107—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010224.

From 14. collegium internationale neuro-psychopharmacologicum; Florence, Italy (19 Jun 1984).

Using ^{18}F-spiperone, a one compartment system with a driving function as model, blocking agents such as butaclamol and ketanserin, assay of the live adult female baboon striatum over the 8 h period, and assay of the parent compound in plasma, it is apparent that residence times in the living tissue and those estimated from in vitro tritium data are at variance. Occupancy rises to a maximum for ^{18}F benperidol and ^{18}F haloperidol after ~ 25 minutes and for ^{18}F spiperone after ~ 75 minutes, but the striatum concentration of ^{18}F-spiperone and benperiodol remain nearly constant over an eight hour period whereas ^{18}F haloperidol concentration starts falling almost immediately to half its maximum value at 8 hrs. The best fit to our current data gives a preliminary off rate constant of 0.0057 min^{-1}.

27129 **(ISH—16) Measurement of population exposure by radiological screening in private companies in Berlin.** Dreyer, U. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). Jun 1982. 67p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.).

In the first quarter of 1975, 21,647 employees (males: 16,336; females: 5,311) of private companies in Berlin were screened. The mean number of exposures per examination was 2.3 (2.3 in males, 2.2 in females). The genetically significant doses (GSD) of this group was calculated to be 1.514 mrem/a.

27130 **Imaging local brain function with emission computed tomography.** Kuhl, D.E. (UCLA School of Medicine, Los Angeles, CA). *Radiology;* **150**: No. 3, 625-631(Mar 1984). Contract AC03-76SF00012.

From 68. scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL, USA (28 Nov 1982).

Positron emission tomography (PET) using ^{18}F-fluorodeoxyglucose (FDG) was used to map local cerebral glucose utilization in the study of local cerebral function. This information differs fundamentally from structural assessment by means of computed tomography (CT). In normal human volunteers, the FDG scan was used to determine the cerebral metabolic response to conrolled sensory stimulation and the effects of aging. Cerebral metabolic patterns are distinctive among depressed and demented elderly patients. The FDG scan appears normal in the depressed patient, studded with multiple metabolic defects in patients with multiple infarct dementia, and in the patients with Alzheimer disease, metabolism is particularly reduced in the parietal cortex, but only slightly reduced in the caudate and thalamus. The interictal FDG scan effectively detects hypometabolic brain zones that are sites of onset for seizures in patients with partial epilepsy, even though these zones usually appear normal on CT scans. The future prospects of PET are discussed.

27131 **Recent developments in detectors for high spatial resolution positron CT.** Yamashita, Y.; Hayashi, T.; Uchida, H.; Yamashita, T. (Hamamatsu Photom'cs K.K, 1126-1 Ichino-Cho, Hamamatsu City). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 424-428(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Experiments using three types of detectors for high spatial resolution positron computed tomography have been carried out as follows: one-to-one coupling between a BGO sciintillator and a thin rectangular photomultiplier tube (PMT); combining a small position sensing PMT with two BGO scintillators; and combining a large PMT with two or more BGO scintillators and using other detectors--small PMT's or silicon photodiodes (SiPD's) for scintillator identification. The time resolution obtained in the first method was poorer than that of the other methods due to the present status of thin PMT performance--poor cathode sensitivity. In the second method and in the third method utilizing the small PMT's, good time resolution and position sensing were obtained. In the third method utilizing the SiPD's, the peak-to-valley ratio of 1.8 in pulse height spectrum was obtained with a cooled BGO scintillator and a SiPD.

27132 **Some aspects of the construction of HISPET: a high spatial resolution positron emission tomograph.** Bellazini, R.; Del Guerra, A.; Massai, M.M.; Nelson, W.R.; Perez-Mendez, V.; Schwartz, G. (University of Pisa, Dept. of Physics, Piazza Torricelli 2, Pisa). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 645-648(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors describe the improvements achieved toward the construction of a large solid angle Positron Camera, made of six dense drift space MWPC modules, arranged to form the lateral surface of a hexagonal prism. The tomograph will have an intrinsic spatial resolution of $\leqq$ 4.5 mm (FWHM) and a volume sensitivity of about100000 c/s per 0.1 μCi/ml, for a signal to noise of 3:1.

27133 **Modeling of accidental coincidences in both conventional and time-of-flight positron-emission tomography.** Holmes, T.J.; Ficke, D.C.; Snyder, D.L. (Inst. for Biomedical Computing, Mallinkrodt Inst. of Radiology, and Dept. of Electrical Engineering, Washington Univ., St. Louis, MO 63110). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 627-631(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Mathematical predictions of the improvement in image signal-to-noise ratio that results when time-of-flight information is used in positron emission tomography are smaller than the improvement observed experimentally. It has been conjectured that the additional performance gain is due to the way in which accidental coincidences are suppressed by the time-of-flight data acquisition and reconstruction processes. This paper summarizes a mathematical model which has been extended to include the effects of accidental coincidences and which supports, upon analysis and comparison with experimental data, the above conjecture. For simplicity the authors analyze only two types of tomographic processing: the filtered-back-projection technique of conventional tomography and the confidence-weighting technique of time-of-flight tomography. Intuition about these techniques, both of which employ linear filtering methods, leads to the definition of an "effective coincidence-timing window" for time-of-flight instruments as a comparative metric of the suppression of accidental coincidences. The measurement processes underlying the model are given as is the photon detection instrumentation.

27134 **Performance figures and images from the therascan 3128 positron emission tomograph.** Cooke, B.E.; Alarie, K.; Evans, A.C.; Fanthome, E.O.; Sendyk, A.M. (Atomic Energy of Canada Limited, Medical Products Division 413 March Road, P.O. Box 13500, Kanata, Ontario CANADA K2K 1X8). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 640-644(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The THERASCAN 3128 system has been designed to study cerebral function using positron emission tomography (PET) methods. Two rings of bismuth germanate (BGO) detectors define three image planes per scan. For the low resolution mode image resolution is 19 mm x 19 mm x 20 mm (axial) and the direct slice sensitivity for true coincidences is 88 kcps/(μCi.cm^{-3}). In the high resolution mode image resolution is 12 mm x 12 mm x 12 mm with a sensitivity of 33 kcps/(μCi.cm^{-3}). Deconvolution methods used to remove scattered events have been verified by repeated imaging of a phantom designed to provide a wide variation in contrast with time. Clinical images from ^{18}F-2-fluorodeoxyglucose (FDG) and ^{15}O studies are presented as practical examples of system performance and to illustrate the useful information obtained from coronal/sagittal sectioning of closely spaced transverse images.

27135 **Performance characteristics of the McMaster positron emission tomograph.** Nahmias, C.; Firnau, G.; Garnett, E.S. (Nuclear Medicine, Section of Radiology, McMaster University, 1200 Main Street West, Hamilton, Ontario L8N 3Z5). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 637-639(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The McMaster Positron Emission Tomograph is an instrument designed for the high resolution cross sectional study of the human brain. The detector head comprises 160 Bismuth Germanate crystals, each coupled to a 12.7 mm photomultiplier tube, closely packed on a ring, 53.5 cm in diameter. The performance characteristics of the tomograph have been measured. The spatial resolution is 8 mm (FWHM) in the stationary mode. The slice thickness is 10 mm. The resolution element is a cube of side 8 mm. The sensitivity of the tomograph was measured using a cylindrical lucite phantom, 20 cm in diameter and 20 cm long, uniformly filled with a 1 μCi/ml solution of ^{68}Ga. The total number of coincident events is 18,200 cps for a 10 mm slice. Of these, 2200 cps are random coincidences. The instrument has been in clinical use for the past 8 months.

27136 **A stationary positron emission ring tomograph using BGO detector and analog readout.** Burnham, C.A.; Bradshaw, J.; Brownell, G.L.; Chester, D.; Kaufman, D. (Massachusetts General Hospital, Physics Research Lab., Boston MA 02114). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 632-636(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A single ring PET camera has been constructed to demonstrate the use of one dimensional scintillation camera techniques in positron tomographic design. A pseudo-continuous BGO detector is used. The detector is 46 cm ID, 52 cm OD, 2 cm wide and is made using 360 elements. A narrow light guide and 90 PM Tubes are used for the readout. The position of coincident events are found using unique scintillation camera logic.

27137 **Initial characterization of a bgo-Photodiode detector for high resolution positron emission tomography.** Derenzo, S.E. (Donner Lab. and Lawrence Berkeley Lab., Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 620-626(Feb 1984). (CONF-831015—). Contract AC03-76SF00098.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Spatial resolution in positron emission tomography is currently limited by the resolution of the detectors. This work presents the initial characterization of a detector design using small bismuth germanate (BGO) crystals individually coupled to silicon photodiodes (SPDs) for crystal identification, and coupled in groups to phototubes (PMTs) for coincidence timing. A 3 mm x 3 mm x 3 mm BGO crystal coupled only to a SPD can achieve a 511 keV photopeak resolution of 8.7% FWHM at -150°C, using a pulse peaking time of 10 μs. When two 3 mm x 3 mm x 15 mm BGO crystals are coupled individually to SPDs and also coupled to a common 14 mm diam PMT, the SPDs detect the 511 keV photopeak with a resolution of 30% FWHM at -76°C. In coincidence with an opposing 3 mm wide BGO crystal, the SPDs are able to identify the crystal of interaction with good signal-to-noise ratio, and the detector pair resolution is 2 mm FWHM.

27138 **Results of a comparative study of a reconstruction procedure for producing improved estimates of radioactivity distributions in time-of-flight emission tomography.** Politte, D.G.; Snyder, D.L. (Department of Electrical Engineering and Institute for Biomedical Computing Washington University St. Louis, Missouri 63110). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 614-619(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Several reconstruction algorithms for estimating distributions of radioactivity in an emission-tomography system having time-of-flight measurements have previously been identified. We present here a comparative study of various images reconstructed from data acquired with an emission-tomography system having time-of-flight data. Preliminary results indicate that a new recursive algorithm provides substantial improvements in image quality.

27139 **Dynamic imaging with high resolution time-of-flight pet camera - TOFPET I.** Mullani, N.A.; Bristow, D.; Gaeta, J.; Gould, K.L.; Hartz, R.K.; Philipe, E.A.; Wong, W.H.; Yerian, K. (University of Texas Health Science Center Division of Cardiology 6431 Fannin, Houston, Texas 77030). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 609-613(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

One of the major design goals of the TOFPET I positron camera was to produce a high resolution whole body positron camera capable of dynamically imaging an organ such as the heart. TOFPET I is now nearing completion and preliminary images have been obtained to assess its dynamic and three dimensional imaging capabilities. Multiple gated images of the uptake of Rubidium in the dog heart and three dimensional surface displays of the distribution of the Rubidium-82 in the myocardium have been generated to demonstrate the three dimensional imaging properties. Fast dynamic images of the first pass of a bolus of radio-tracer through the heart have been collected with 4 second integration time and 50% gating (2 second equivalent integration time) with 18 mCi of Rb-82.

27140 **Recent developments in image reconstruction using a time-of-flight-assisted positron emission tomograph: Super Pett I.** Ficke, D.C.; Beecher, D.E.; Hoffman, G.R.; Holmes, T.J.; Ter-Pogossian, M.M. (The Edward Mallinckrodt Institute of Radiology and Institute for Biomedical Computing Washington University School of Medicine St. Louis, Missouri 63110). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 605-608(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

One recent development in image reconstruction utilizing time-of-flight information yields a compression of the three dimensional array used in forming the unfiltered "preimage." A reduction from 96 angles to 16 angles is shown to produce equivalent quality images and may form a basis for future architectural strategies. A second development in image reconstruction can strongly affect the quality of results when constraints such as cardiac gating are imposed, while not inherently sacrificing spatial resolution due to inadequate sampling. A correction for sampling density obtained by analyzing list mode data is shown to greatly reduce circular artifact production. This technique is extendable to systems without time-offlight measurements and to scanning motions other than wobbling.

27141 **Development of small in-vivo imaging probes for tumor detection.** Barber, H.B.; Barrett, H.H.; Wild, W.J.; Woolfenden, J.M. (Division of Nuclear Medicine, Univ. of Ariz. Health Sciences Center, Tucson, AZ 85724). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 599-604(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The authors have developed coded-aperature γ-ray imaging devices which are small enough to be incorporated in medical probes that are inserted into the upper or lower gastrointestinal tract to image concentrations of tumor-seeking radiotracers. They have designed two different types of imaging probes, rotating and nonrotating, and have constructed and tested prototypes of each.

27142 **Germanium-scintillation camera coincidence detection studies for imaging single photon emitters.** Singh, M.; Doria, D. (Inst. for Physics and Imaging Science, 4676 Admiralty Way, Suite 932, Marina del Rey, CA 90292). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 594-598(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A prototype system has been used to measure the point spread function (PSF) and sensitivity characteristics of a germanium-scintillation camera (GSC) system for imaging single photon emitters. A detector consisting of two 5mm x 5mm x 6mm elements, fabricated on a single piece of high purity germanium, and a Pho/gamma HP scintillation camera were used. Experiments were conducted with a point source of Tc-99m to specify the threshold and energy resolution required in the germanium detector and to study the timing characteristics of coincidence detection.

27143 **Dual energy attenuation correction for single photon emission computed tomography (SPECT).** Nalcioglu, O.; Bor, D. (Dept. of Radiological Sciences, Univ. of California, Irvine, CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 590-593(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Absorption of gamma rays by matter causes the well known attenuation artifacts in SPECT. In this paper, the authors investigate a technique in which projections acquired at two different energies are used. The projections resulting from the two energies are manipulated to extract the true radioisotope distribution within the slice reducing the attenuation problems. Simulation results are presented for different phantoms investigating the amount of artifacts with and without the correction. It is shown that the dual energy technique can be used in obtaining accurate SPECT images with very little attenuation artifacts.

27144 **A modular scintillation camera for use in nuclear medicine.** Milster, T.D.; Arendt, J.; Barrett, H.H.; Easton, R.L.; Rossi, G.R.; Selberg, L.A.; Simpson, R.G. (Department of Radiology Arizona Health Sciences Center University of Arizona Tucson, Arizona 85724). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 578-580(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A "modular" scintillation camera is discussed as an alternative to using Anger cameras for gamma-ray imaging in nuclear medicine. Each module is an independent gamma camera and consists of a scintillation crystal, light pipe and mask plane, PMT's, and processing electronics. Groups of modules efficiently image radionuclide distributions by effectively utilizing crystal area. Performance of each module is maximized by using Monte-Carlo computer simulations to determine the optical design of the camera, optimiz-

ing the signal processing of the PMT signals using maximum-likelihood (ML) estimators, and incorporating digital lookup tables. Each event is completely processed in 2 μsec, and FWHM of the PSF over the crystal area is expected to be 3 mm. Both one-dimensional and two-dimensional prototypes are tested for spatial and energy resolution

27145 **NMR microscopy.** House, W.V. (Mag Scan, Inc. P.O. Box 540324 Houston, TX 77254). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 570-578(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

There are theoretical and practical constraints which limit the resolution, and contrast obtainable from an NMR imaging microscope.

27146 **Dual gated nuclear cardiac images.** Zubal, I.G.; Bennett, G.W.; Bizais, Y.; Brill, A.B. (Medical Dept., Brookhaven Nat'l. Laboratory, Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 566-569(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A data acquisition system has been developed to collect camera events simultaneously with continually digitized electrocardiograph signals and respiratory flow measurements. Software processing of the list mode data creates more precisely gated cardiac frames. Additionally, motion blur due to heart movement during breathing is reduced by selecting events within a specific respiratory phase. Thallium myocardium images of a healthy volunteer show increased definition. This technique of combined cardiac and respiratory gating has the potential of improving the detectability of small lesions, and the characterization of cardiac wall motion.

27147 **Gated cardiac scanning using limited-angle image reconstruction technique and information in the neighboring phases.** Tam, K.C.; MacDonald, B.; Perez-Mendez, V. (G.E. Corporate Research and Development Center, Schenectady, NY 12345). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 562-565(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

It is known that there are gaps in scan angle in gated cardiac scanning due to lack of synchronization between heart beat and CT machine rotation. The missing projections in these gaps result in artifacts in the reconstructed images. In a previous paper an iterative limited-angle reconstruction technique was employed to fill in the missing projections to remove the artifacts. It was found there that the root-mean-square errors of the limited-angle images were reduced to a level comparable to those of reconstructions using complete-angle information. In the present paper the results are further improved by using the scans of a neighboring portion of the cardiac cycle as a first estimate of the missing scans in the phase of interest when initializing the iterations. Such a modification provides a better starting point for the iterations.

27148 **Geometry study of a high resolution pet detection system using small detectors.** Lecomte, R.; Lamoureux, G.; Schmitt, D. (Dept. of Nuclear Medicine, University of Sherbrooke, Quebec). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 556-561(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The current trend in positron emission tomography (PET) towards very high spatial resolution tomographs raises the problem of detecting high energy gamma-rays with a high spatial accuracy while preserving the overall sensitivity of the camera. It is the purpose of this paper to investigate the effects of some geometrical parameters on the detection efficiency and intrinsic spatial resolution of a circular array of narrow closely packed detectors. Two approaches were employed: the first one uses the Monte-Carlo technique to simulate the interactions of gamma-rays in the detectors; the second one is based on the linear attenuation on a beam of gamma-rays impinging on a detector array. Aperture functions and modulation transfer functions were obtained for various configurations of the detectors and septas. Expressions for the resolution and the spectral signal-tonoise ratio were derived. It is shown that minor modifications to the geometry can improve both the efficiency and intrinsic resolution of the detector array.

27149 **Use of heavy water in boron neutron capture therapy of brain tumours.** Slatkin, D.N.; Levine, M.M.; Aronson, A. (Brookhaven National Lab., Upton, NY (USA)). *Physics in Medicine and Biology;* **28**: No. 12, 1447-1451(Dec 1983).

In this note the authors conclude that transient partial deuteration of body water for neutron capture therapy would significantly enhance radiation produced by the neutron-boron reaction at the deep margins of brain tumours and reduce effective gamma radiation to normal brain tissues by 50% or more. This analysis has dealt with totally thermalised incident neutrons.

27150 **High-resolution circular ring positron tomograph with dichotomic sampling: Dichotom-I.** Cho, Z.H.; Hilal, S.K.; Ra, J.B.; Hong, K.S. (Columbia Univ., New York (USA). Dept. of Radiology); Bigler, R.E.; Yoshizumi, T. (Department of Energy, Washington, DC (USA). Div. of Energy Storage Systems); Wolf, A.P.; Fowler, J.S. (Brookhaven National Lab., Upton, NY (USA)). *Physics in Medicine and Biology;* **28**: No. 11, 1219-1234(Nov 1983).

The circular ring transaxial positron camera developed earlier was refitted with a new dichotomic sampling scheme and aperture collimators on the detector array to improve the sampling and the overall system resolution. The z-axis slice thickness collimators were also limited to 1 cm, which corresponds to a slice thickness of 0.5 cm FWHM. Two different types of aperture collimators were adopted for high resolution (HR) and very high resolution (VHR) imaging, respectively. In HR mode a resolution of 6.5 mm FWHM was obtained without appreciable degradation of overall sensitivity, which represents a threefold improvement in resolution over the original system. In phantom studies with HR mode a sensitivity of 4500 counts s^{-1} μCi^{-1} cm^{-3} was obtained for a 20 cm diameter uniform phantom filled with water. A VHR mode experiment was also conducted to observe the ultimate resolution capability of the Dichotom-I system, and a resolution of 4.2 mm FWHM was obtained at the expense of sensitivity which was reduced by a factor of four from the HR mode experiment. The experience gained with Dichotom-I suggests a relatively simple and inexpensive modification of the existing NaI(T1) ring positron cameras, most of which suffer from low resolution due to poor sampling and poor intrinsic detector resolution.

27151 **Tin-117m-labeled stannic (Sn^{4+}) chelate of diethylenetriamine pentaacetic acid (DTPA) for application in diagnosis and therapy.** Srivastava, S.C.; Meinken, G.E.; Richards, P. (to Dept. of Energy). US Patent Application 6-526,251. 25 Aug 1983. 9p. Contract AC02-76CH00016.

Portions are illegible in microfiche products.

The radiopharmaceutical reagents of this invention and the class of Tin-117m radiopharmaceuticals are therapeutic and diagnostic agents that incorporate gamma-emitting nuclides that localize in bone after intravenous injection in mammals (mice, rats, dogs, and rabbits). Images reflecting bone structure or function can then be obtained by a scintillation camera that detects the distribution of ionizing radiation emitted by the radioactive agent. Tin-117m-labeled chelates of stannic tin localize almost exclusively in cortical bone. Upon intravenous injection of the reagent, the preferred chelates are phosphonate compounds, preferable, PYP, MDP, EHDP, and DTPA. This class of reagents is therapeutically and diagnostically useful in skeletal scintigraphy and for the radiotherapy of bone tumors and other disorders.

27152 **Radionuclide labeled lymphocytes for therapeutic use.** Srivastava, S.C.; Fawwaz, R.A.; Richards, P. (to Dept. of Energy). US Patent Application 6-491,132. 3 May 1983. 17p. Contract AC02-76CH00016.

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Lymphocytes labelled with β-emitting radionuclides are therapeutically useful, particularly for lymphoid ablation. They are

prepared by incubation of the lymphocytes with the selected radionuclide-oxine complex.

27153 **Particle beam accelerators for radiotherapy and radioisotopes.** Boyd, T.J.; Crandall, K.R.; Hamm, R.W. (Los Alamos National Lab., NM (USA)). *Proceedings of the Japan Conference on Radioisotopes;* No. 15, 272-281(1982). (CONF-811153—).

From 15. Japan conference on radioisotopes; Tokyo, Japan (26 Nov 1981).

The clinical trial on the radiation susceptibility of cancers to various types of particle beam has been under active study during the past 10 years. The effects of pions, heavy ions, protons and neutrons have been investigated. After the start of the pion program at LAMPF, a study was initiated by the US National Cancer Institute to develop the design and to test certain components of the accelerators exclusively used for cancer therapy in hospital environment. This program named "Pion Generator for Medical Irradiation" (PIGMI) was completed recently. Significant advance was made in the accelerator technology, and it was indicated that the economical and reliable dedicated machines can be produced. Moreover, the design can be made so as to produce any particle beam that may eventually be desired. The pion machine would be the longest (highest energy) using accelerated protons on a target to produce pion beam. For the production of neutrons, protons or heavy ions, the same components as those used for an initial pion machine would be used with suitable modification. The application to radiotherapy and radioisotopes, the PIGMI technology, PIGMI pion radiotherapy facility and PIGMI radioisotope production machine are described.

5507 Microbiology

REFER ALSO TO CITATION(S) 25591, 25592, 25594, 27104, 27106, 27116, 27176

27154 (CONF-811048—Summs., pp 4p, Paper 85) **Containment facilities for pathological materials.** Clark, R.P. (Clinical Research Centre, Middlesex, England). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

An important area, often neglected in the design and installation of containment facilities, is that of ensuring that safety cabinets and fume cupboards are compatible with heating and ventilation systems. The Medical Research Council in the United Kingdom is currently extending the principles of numerically quantifying containment of safety cabinets and fume cupboards to the quantification of the overall containment provided by the rooms in which these facilities are housed. This containment is defined with respect to corridors and other adjacent areas which need to be isolated from the hazardous material. (DT)

27155 **(PB—84-149590) Tratamiento de mostos utilizando el filtro anaerobio (treatment of must using an anaerobic filter). Master thesis.** Negron, R.M. (Puerto Rico Univ., Mayaguez). Dec 1982. 160p. NTIS, PC A08/MF A01.

This study reports on the feasibility of treating the slops from rum distilleries with an anaerobic filter composed of an oxygen free reactor filled with a plastic filtering media, commercially known as 'Actifil' with a diameter of 5/8 inches (16mm). This filter is similar in appearance to an aerobic biofilter (trickling filter). The main difference between the two systems is that on the anaerobic filter the flow is upward so that the filter medium is always completely submerged.

5508 Morphology

REFER ALSO TO CITATION(S) 26566, 27090

5509 Pathology

REFER ALSO TO CITATION(S) 27107, 27222

27156 (CONF-811048—Summs., pp 8p, Paper 40) **Environmental control of indoor air pollution in hospital and home environment in relation to cardiovascular disease.** Rea, W.J. (Univ. of Texas Southwestern Medical School, Dallas); Smiley, R.E.; Sprague, D.E.; Edgar, R.T.; Fenyves, E.J.; Greenberg, M.; Johnson, A.R. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

A series of patients with environmentally triggered vascular phenomenon have been treated. These patients' symptoms included arrhythmias, spontaneous bruising and petechiae, Raynaud's Phenomenon and peripheral and periorbital edema. Symptoms and signs were cleared when placed in environmentally controlled rooms without medications. The signs and symptoms were reproduced with double blind challenge of subthreshold ambient chemicals. Follow-up of treatment in environmentally controlled homes over a period of two to five years was done. Results show marked improvement in a majority of the patients. (DT)

27157 **Evaluation of body composition and nitrogen content of renal patients on chronic dialysis as determined by total body neutron activation.** Cohn, S.H.; Brennan, B.L.; Yasumura, S.; Vartsky, D.; Vaswani, A.N.; Ellis, K.J. (Brookhaven National Lab., Upton, NY). *American Journal of Clinical Nutrition;* **38**: 52-58(Jul 1983). Contract AC02-76CH00016.

Total body protein (nitrogen), body cell mass (potassium), fat, and water were measured in 15 renal patients on maintenance hemodialysis (MHD). Total body nitrogen was measured by means of prompt γ neutron activation analysis; total body water was determined with tritium labeled water; total body potassium was measured by whole body counting. The extracellular water was determined by a technique utilizing the measurement of total body chloride and plasma chloride. When compared with corresponding values of a control group of the same age, sex, and height, the protein content, body cell mass, and total body fat of the MHD patients were within the normal range. The only significant change was an increase in the extracellular water/body cell mass ratio in the male MHD patients compared to the control. The lack of significant difference of the nitrogen values of the MHD patients compared to matched controls suggests that dialysis minimizes any residual effects of uremic toxicity or protein-calorie malnutrition. These findings further suggest that there is a need to reevaluate the traditional anthropometric and biochemical standards of nutritional status for MHD patients. It was concluded that it is particularly important to measure protein stores of MHD patients with low protein intake to ascertain nutritional status. Finally, in vivo measurement of total body nitrogen and potassium for determination of body composition provides a simple, direct, and accurate assessment of the nutritional status of MHD patients.

27158 **Periodic neutropenia and monocytopenia.** Adams, W.H.; Liu, Y.K. (Texas Tech Univ., Lubbock). *American Journal of Hematology;* **13**: 73-82(1982).

A patient with periodic neutropenia exhibited simultaneous monocytopenia, and epinephrine infusion revealed no monocytes in the marginating pool during neutropenia. Lymphocytes, eosinophils, and platelets also fluctuated periodically, but serial bone marrow studies and epinephrine infusion data indicate these fluctuations could have represented epiphenomena rather than a more global form of periodic hematopoiesis. Bone marrow descriptions of most cases of periodic neutropenia have indicated a "maturation arrest" at the promyelocyte or myelocyte stage prior to development of neutropenia; peripheral blood monocytes are usually normal or fluctuate out of phase with neutrophils. In the present

case, "maturation arrest" occurred at the myeloblast stage, and neutrophils and monocytes cycled together. Morphologically normal eosinophilopoiesis with a mean eosinophil to erythroid ratio in the marrow of 0.27 +/- 0.10 (SD) persisted despite a sustained disappearance of promyelocytes.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 26566

27159 **In vivo quantification of body nitrogen for nutritional assessment.** Cohn, S.H.; Vaswani, A.N.; Vartsky, D.; Yasumura, S.; Sawitsky, A.; Gartenhaus, W.; Ellis, K.J. (Brookhaven National Lab., Upton, NY). *American Journal of Clinical Nutrition;* **35**: 1186-1191(May 1982).

A series of experimental tests were carried out to study total body nitrogen (TBN), total body potassium (TBK), total body water (TBW) and total body calcium (TBCa). The prompt neutron activation and whole body counting techniques were used to measure TBN and TBK, respectively. TBW was measured with the use of the standard tritiated water radioisotopic technique. Three groups of subjects were studied: normal controls, obese women on protein sparing diets, and cancer patients on chemotherapy. In relation to TBN, the obese patients showed a minimal negative nitrogen balance 0.49 to 0.87 g/day. With regard to the cancer patients, the data obtained in this study clearly corroborate the clinical observations. In patients with severe wasting, it is the skeletal muscle mass that is predominantly lost, not the visceral life-supporting system.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 26130, 27117, 27199

27160 (ANL/CNSV-TM—127, pp 9-11) **Adoption and diffusion of agriculture technology.** Jennings, V.M. (Iowa State Univ., Ames). Jan 1984. NTIS, PC A05/MF A01. (CONF-830898—).

From 1. conference on energy from biomass: building on a generic technology base; Argonne, IL, USA (22 Aug 1983).

The processes whereby new techniques are adopted into use in agriculture are briefly described. Specifically, how the process works in a Land Grant Institution is explained. How the technology adoption works in research and how it is utilized by the Extension Service at the local level where it is adopted by clientele are addressed. The process consists of awareness, interest, evaluation, trial, and finally adoption. (DMC)

27161 **(TVA/ONRED/AWR—84/7) Summary of channel catfish and rainbow trout production at the Gallatin Waste Heat Aquaculture Facility, 1979-1980.** Collins, C.M.; Schweinforth, R.L.; Burton, G.L. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Feb 1984. 92p. NTIS, PC A05/MF A01. Order Number DE84900929.

These studies have indicated that channel catfish and rainbow trout can be intensively cultured in concrete raceways using waste heat effluent water from the Gallatin Steam Plant. Optimum production was attained, especially with channel catfish, when desirable water temperatures and proper environmental conditions occurred. High density culture is possible during the winter and early spring months.

27162 **Neutron radiography technique for studying young roots growing in soil.** Struss, R.G. (Ames Lab., IA (USA)). pp 581-590 of Neutron radiography. Proceedings of the first world conference San Diego, California, USA, December 7-10, 1981. Barton, J.P. (Neutron Radiography Consulting, La Jolla, CA (USA)); Hardt, P. von der (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center) (eds.). Dordrecht, Netherlands; D. Reidel (1983). (CONF-811215—).

From 1. world conference on neutron radiography; San Diego, CA, USA (7 Dec 1981).

Includes author index.

An indirect technique for taking neutron radiographs using indium collector foils has been used to study seed germination and root growth in soils. This paper describes the work done at Ames Laboratory Research Reactor, Ames, Iowa, in 1977-1978 to develop this technique for in situ studies to replace destructive sampling techniques. A diverging thermal neutron (.04 eV) beam of 10^7 n/cm^2/sec was used to irradiate samples for 8 to 10 min. to a total exposure of 5×10^9 n/cm^2. Plants grown in loamy sand soil wetted to 9% volumetric water content in aluminum boxes of 2.5 and 5 cm thickness were photographed with this technique. An indium collector plate attached to the back of the box produced a transfer screen during exposure in the neutron beam which was subsequently placed in direct contact with photographic film to produce an image of the plant roots.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 27037, 27038

27163 **(ARL/TR—054) Evaluation of Amerscan Technetium (tin colloid) Agent for liver scintigraphy.** Van Every, B. (Australian Radiation Lab., Melbourne). May 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700909.

A study was made of the effect of elevated levels of aluminium ion and carrier technetium in the sodium pertechnetate (Tc-99m) used for the reconstitution of Amerscan Technetium (tin colloid) Agent. Up to 20 ppm aluminium or 50 ng Tc/mL in the sodium pertechnetate (Tc-99m) used for reconstitution had only a slight effect on both the biological distribution and radiochemical purity of the reconstituted product.

27164 **(CONF-830665—5) Analytical methods under emergency conditions.** Sedlet, J. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010523.

From Health Physics Society summmer school on internal radiation dosimetry; Catonsville, MD, USA (12 Jun 1983).

This lecture discusses methods for the radiochemical determination of internal contamination of the body under emergency conditions, here defined as a situation in which results on internal radioactive contamination are needed quickly. The purpose of speed is to determine the necessity for medical treatment to increase the natural elimination rate. Analytical methods discussed include whole-body counting, organ counting, wound monitoring, and excreta analysis. 12 references. (ACR)

27165 **(DOE/EV/03382—22) Metabolic studies of neptunium in the adult baboon: retention, distribution, kinetics, and enhanced excretion by chelation therapy. Technical progress report summary.** (New York Univ., NY (USA). Inst. of Environmental Medicine). 1984. Contract AC02-76EV03382. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010503.

These investigations provided additional data on the uptake, distribution, retention and excretion of Np-237, Np-239 and Pa-233 in baboons following single intravenous or gavage administration. The influence of oxidation state, chemical medium, pH, mass, etc. on the metabolism of these radionuclides is related.

27166 **(LA—9462-MS) Quality control activities in support of the plutonium workers study. Assessment of coding consistency for data collected at Rocky Flats.** Reyes, M.; Wilkinson, G.S.; Acquavella, J.F. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011016.

The Plutonium Workers Study is a multifaceted epidemiologic investigation of workers at six Department of Energy (DOE) facilities: Los Alamos, Rocky Flats, Mound, Savannah River, Oak

Ridge, and Hanford. Information from a variety of record sources has been collected and abstracted for these studies. This report considers the accuracy of the demographic, occupational, and radiation exposure data collected for studies at Rocky Flats. the majority of the information was accurately abstracted, and analyses based on these data may be conducted.

27167 **(NUREG/CR—3677) Comparison of radon fluxes with gamma-radiation exposure rates and soil ^{226}Ra concentrations.** Young, J.A.; Thomas, V.W. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 24p. (PNL—5016). NTIS, PC A02/MF A01; 1 - GPO $3.25; GPO Dep. Order Number DE84010937.

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Radon fluxes and contact gamma-radiation-exposure rates were measured at the grid points of rectangular grids on three properties in Edgemont, South Dakota that were known to have deposits of residual radioactivity relatively near to the surface. The coefficient of determination, r^2, between the radon fluxes and the contact gamma-radiation-exposure rates varied from 0.89 to 0.31 for the three properties. The property having the highest fluxes and residual radioactivity of relatively uniform depth showed the highest correlation between fluxes and exposure rates, and the property having residual radioactivity that varied considerably in depth showed the lowest. Correlations between fluxes and ^{226}Ra concentrations measured in boreholes that varied in depth from 60 to 195 cm were lower than those between fluxes and exposure rates, indicating that exposure rates are better than ^{226}Ra measurements for detecting elevated radon fluxes from near-surface deposits. Measurements made on one property at two different times indicated that if the average flux were determined from a large number (40) of measurements at one time, the average flux at a later time could be estimated from a few measurements using the assumption that the change in the flux at individual locations will be equal to the change in the average flux. Flux measurements around two buildings showing elevated indoor radon-daughter concentrations, but around which no residual radioactivity had been discovered by ^{226}Ra and gamma-radiation measurements, provided no clear indication of the presence of such material, possibly because none was present.

27168 **(ORNL/TM—9138) Bibliography of literature relevant to the reassessment of A-bomb radiation dosimetry in Hiroshima and Nagasaki.** Kerr, G.D. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010667.

Radiation doses received by the survivors of the Hiroshima and Nagasaki bombings were estimated in increasingly sophisticated studies between 1950 and 1965. The latest of these estimates, designated as Tentative 1965 Doses or simply T65D values, were used as a basis for risk assessment throughout the 1970's. The T65D values have recently been subjected to critical review as a result of concern over possible changes in radiation protection standards. Thus, it is essential that the reassessment of A-bomb radiation dosimetry is well-documented and that the results are convincing to the scientific community. This bibliography provides a keyword index, author index, and master listing of over 100 published reports dealing with different aspects of the dosimetry reassessment effort.

27169 **(PNL-SA—11777) Factors affecting plant absorption, transport and fate of plutonium.** Garland, T.R.; Cataldo, D.A.; McFadden, K.M.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 49p. (CONF-8311110—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011360.

From 6. workshop on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1983).

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This study determined the extent to which several agricultural plants control plutonium (Pu) uptake and provides a general understanding of the fate and behavior of Pu in plants after absorption. Investigations were directed toward variables affecting the accumulation of Pu by plants from soils, transport of Pu within the plant, factors affecting transport with plant age, effects of different plant species on transport processes, form of Pu deposited in plant tissues, and effect of chemical form on animal gut absorption of Pu. 18 references, 10 figures, 14 tables.

27170 **(PNL-SA—11778) Aspects of neptunium behavior in plants; absorption, distribution, and fate.** Cataldo, D.A.; Garland, T.R.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 19p. (CONF-8311110—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010877.

From 6. workshop on environmental research for actinide elements; Hilton Head Island, SC, USA (7 Nov 1983).

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The availability of Np(V) for absorption by plants and its subsequent transport and fate are described. Plant uptake of Np from solutions containing 7×10^{-7} to 473 μg Np/ml is proportional to concentration, exhibiting some saturation at higher concentrations. Soil studies using Np concentrations of 5.2×10^{-7} to 4.1 μg/g soil show CR values to be constant at $\sim$ 2 at soil concentrations below 4×10^{-4} μg/g, and increase to 12 at higher soil levels. Soil/plant CR values vary with plant species and range from 0.5 to 4; seed concentrations are a factor of 10 lower than vegetative tissues. Fractionation of plant tissues show Np to be substantially more soluble than Pu, with $\sim$ 50% of the soluble Np being associated with plant ligands of $<$ 5000 MW. 6 references, 5 figures, 1 table.

27171 **(PNL-SA—12101) Statistical lung model for microdosimetry.** Fisher, D.R.; Hadley, R.T. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 8p. (CONF-8403115—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010703.

From Workshop on lung modeling for inhalation of radioactive materials; Oxford, UK (26 Mar 1984).

To calculate the microdosimetry of plutonium in the lung, a mathematical description is needed of lung tissue microstructure that defines source-site parameters. Beagle lungs were expanded using a glutaraldehyde fixative at 30 cm water pressure. Tissue specimens, five microns thick, were stained with hematoxylin and eosin then studied using an image analyzer. Measurements were made along horizontal lines through the magnified tissue image. The distribution of air space and tissue chord lengths and locations of epithelial cell nuclei were recorded from about 10,000 line scans. The distribution parameters constituted a model of lung microstructure for predicting the paths of random alpha particle tracks in the lung and the probability of traversing biologically sensitive sites. This lung model may be used in conjunction with established deposition and retention models for determining the microdosimetry in the pulmonary lung for a wide variety of inhaled radioactive materials.

27172 **(PNL-SA—12130) Mean dose vs local dose to the respiratory tract: implications for radiological protection.** Cross, F.T.; Bair, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 18p. (CONF-8403115—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010845.

From Workshop on lung modeling for inhalation of radioactive materials; Oxford, UK (26 Mar 1984).

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This paper explores data and concepts relevant to the use of mean lung doses versus local or regional lung doses in radiological protection systems. Exposures to different patterns of high-LET alpha radiations are compared on dosimetric and biological effects bases. We show that inhalation exposures to short-lived radon daughters and to insoluble plutonium produce comparable tumorigenic responses, when radiation doses are compared on a mean lung dose basis, in spite of very different regional lung-dose distributions. These data suggest that, for the pragmatic purposes of radiological protection, no greater refinements in dosimetry are required. Additional data are presented that support mean lung dose alpha-quality factors greater than 20 or an increase in the ICRP risk coefficient for lung cancer to provide consistency with current radon daughter epidemiologic data and experimental animal data.

27173 **Similar ultraviolet action spectra for the protection by glycerol of transforming DNA against single-strand breaks and inactivation of biological activity.** Peak, J.G.; Peak M.J. (Argonne National Lab., IL). *Radiation Research;* **97**: No. 3, 570-575(Mar 1984). Contract W-31-109-ENG-38.

An action spectrum for the protection of purified DNA by glycerol against the induction of single-strand breaks in the DNA by ultraviolet (uv) light is described. Protection was not observed below 300 nm, was maximal between 334 and 365 nm, and decreased at 405 nm. This spectrum closely matched the spectrum for the protection by glycerol against the inactivation of biological transforming activity by near uv, described previously. Also, deviations from the reciprocity rule are similar for inactivation of transforming activity and for induction of DNA breaks by 365-nm radiation. That is, the deviations for the two end points are quantitatively the same, such that high fluence rates are less effective than low fluence rates.

27174 **Increased yields of exchanges but not of deletions in X-irradiated human peripheral lymphocytes following phytohemagglutinin stimulation.** Gundy, S.; Bender, M.A. (Frederic Joliot-Curie National Inst. for Radiobiology and Radiohygiene, Budapest, Hungary). *Radiation Research;* **97**: No. 3, 519-525(Mar 1984).

Human peripheral lymphocytes have been irradiated after various intervals of phytohemagglutinin stimulation to determine the time course for exchange induction and to determine whether or not deletion yields increase with increasing intervals of stimulation. No increase in deletion yields were found for intervals up to 12 hr, and rings and dicentric yields increased by about 60% in the interval between 0 and 6 hr but then reached a plateau. Induced unscheduled DNA synthesis was also measured during the same interval and was found to generally increase during the first 6 hr like exchange yields, but then tended to decrease again.

27175 **Coulter volume cell sorting to improve the precision of radiation survival assays.** Freyer, J.P.; Wilder, M.E.; Raju, M.R. (Los Alamos National Lab., NM). *Radiation Research;* **97**: No. 3, 608-614(Mar 1984).

A new method for measuring cell survival at low doses of ionizing radiation has been developed through the use of flow cytometric cell sorting on the basis of Coulter volume signals. The cell sorter is capable of defecting a precisely known number of cells directly into culture dishes, thus eliminating any errors associated with cell dilution and volume sampling. The use of Coulter volume signals as the sorting parameter is shown to be noncytotoxic for a variety of cell lines. Comparison of radiation survival curves measured above the 10% survival level by either the cell sorter or standard dilution assay demonstrates the increased precision of the cell sorter technique. Because of these advantages of cell sorting over conventional methods of plating cells, this technique has many applications in the field of radiation biology and other studies of cell survival.

27176 **Role of hydroxyl radical svengers in preventing DNA strand breaks induced by X irradiation of toluene-treated Escherichia coli.** Billen, D. (Oak Ridge National Lab., TN). *Radiation Research;* **97**: No. 3, 626-629(Mar 1984). Contract W-7405-ENG-26;AS05-76EV04568.

The purpose of this study was to determine whether chemical protection against single-strand breaks observed in toluene-treated E. Coli subjected to X irradiation in air was due to the removal of OH radicals, or resulted from the production of secondary radicals. In toluene-treated cells, DNA strand-break production can be measured without the complication of strand ligation during or immediately following X-ray exposure since such cells are deficient in DNA ligase activity.

27177 **Tumor induction in BALB/c mice after fractionated or protracted exposure to fission-spectrum neutrons.** Ullrich, R.L. (Oak Ridge National Lab., TN). *Radiation Research;* **97**: No. 3, 587-597(Mar 1984). Contract W-7405-ENG-26.

This study has examined the effect of dose rate or fractionation on the carcinogenic effects of fission neutrons with emphasis on the dose range below 50 rad. The induction of lung adenocarcinomas, mammary adenocarcinomas, and ovarian tumors in female BALB/c mice was examined after whole-body neutron irradiation delivered at a high dose rate as a single exposure, or delivered as two equal fractions separated by intervals of 24 hr or 30 days and compared these effects to those after neutron irradiation at low dose rates. The dose responses for ovarian tumorigenesis after the split-dose fractionation regimen were similar to that observed after single high-dose-rate neutron exposure. However, lowering the dose rate reduced the incidence over the dose range of 0-50 rad. For lung and mammary tumors the results were more complex. These data suggest that fractionation and dose-rate effects are different for different tumor types presumably because of the different mechanisms of tumorigenesis that may be involved.

27178 **Link between the environment and cancer: DOE's research efforts. Hearing before the Subcommittee on Natural Resources, Agriculture Research and Environment, U.S. House of Representatives, Ninety-Eighth Congress, first session, 3 Mar 1983.** Washington, DC; Government Printing Office (1984). 126p.

Spokesmen for the Brookhaven and Oak Ridge National Laboratories, the Lovelace Inhalation Toxicology Research Institute, and the University of California Los Angeles School of Medicine described research programs which seek to link human exposure to radiation and chemicals used in energy production to cancer. They addressed the committee's concern that DOE budget cuts will limit the identification of causes of cancer and the effort to find cures. DOE's budget request of $210 million for environmental programs in 1984 is 21% less than the 1984 level. The witnesses described their research in detail in order to justify continued funding.

27179 **Current views on health effects of uranium mill tailings.** Marks, S.; Cross, F.T.; Denham, D.H.; Kennedy, W.E. Jr. (Battelle Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *Transactions of the American Nuclear Society;* **45**: 46(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

27180 **Manned spacecraft radiation dosimetry.** Benton, E.V. (University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117). *Transactions of the American Nuclear Society;* **45**: 226(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

27181 **Measurement of lymphoblastogenic activity from thorium workers.** Serio, C.S.; Henning, C.B.; Toohey, R.E.; Lloyd, E.L. (Argonne National Lab., IL (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* **44**: No. 3, 251-256(Sep 1983).

Mitogenic stimulation of peripheral blood lymphocyte cultures obtained from 36 thorium workers was studied to determine whether the response of these cells was affected by the individuals' occupational exposure to alpha irradiation. The standard assay involved incubating 2 x 10^5 lymphocytes per test well 72 hours in the presence of phytohemagglutinin (PHA), concanavalin A (Con A) or pokeweed mitogen (PWM). The results showed that there was a significant decrease in lymphocyte responsiveness of former thorium workers grouped by decade of life when compared with controls of the same decade of life for each mitogen tested with the exceptions of PHA in the 41-50 age group and PWM in the 51-60 age group. We are unable to correlate the decreased response observed with the measured body burdens, external gamma exposure, or thoron exhalation rates in these thorium cases. However, other occupational exposures (i.e., various chemicals used in processing thorium) cannot be eliminated as a possible cause.

27182 Irradiation of circular DNA with 254 nm radiation or sensitization in the presence of Ag^+ evidence for unwinding by photoproducts other than pyrimidine dimers. Ciarrocchi, G. (Istituto di Genetica Biochimica ed Evoluzionistica del C.N.R., Pavia (Italy)); Sutherland, B.M. (Brookhaven National Lab., Upton, NY (USA)). *Photochemistry and Photobiology;* **38**: No. 3, 259-263(Sep 1983).

Structural alterations of DNA irradiated with UV light were analyzed. Relaxed, circular pAT 153 DNA molecules were sensitized by broad band radiation with a maximum at 313 nm in the presence of silver ions or irradiated with 254 nm light in buffer only. In both cases the electrophoretic mobility of DNA topoisomers was altered as a linear function of UV exposure. For DNA irradiated in the sensitized reaction the unwinding angle per site sensitive to Micrococcus luteus pyrimidine dimer endonuclease was found to be -11.4°. The irradiated DNAs were a very good substrate for the Escherichia coli photoreactivating enzyme (PRE). However, the photoenzymic removal of all sites sensitive to the endonuclease specific for pyrimidine dimers was not coupled to a full restoration of the original electrophoretic mobility. Thirty and 23% of the unwinding were still present in the photoreactivated topoisomers and the unwinding angles per pyrimidine dimer were then recalculated as -10.1° and -8.7° for DNAs irradiated with 254 nm and sensitized, respectively. These results show that the tertiary structure of DNA is measurably altered by UV photodamages other than pyrimidine dimers.

27183 Role of the supX gene in sensitizing Salmonella typhimurium cells to respiration shutoff induced by far ultraviolet irradiation. Swenson, P.A.; Riester, L.; Palmer, T.V. (Oak Ridge National Lab., TN (USA)). *Photochemistry and Photobiology;* **38**: No. 3, 305-310(Sep 1983).

Salmonella typhimurium strains with supX mutations are known to be sensitive to UV (254 nm) irradiation and to be protected by plasmid pKM101. Wild type ($supX^+$) cells shut off their respiration after UV and are protected against their shutoff by pKM101. Respiration and survival studies were carried out on several supX strains. The supX strains shut off their respiration after low fluences of UV. Plasmid pKM101 protected a supX83 (nonsense mutation) strain against respiration shutoff and killing but did not protect a supX35 (deletion mutation) strain. When each of the two supX genes were in the genetic backgrounds of the other, however, full protection was provided by pKM101. The supX35 strain not protected by pKM101 may have accumulated a modifying mutation. The supX locus is identical with one specifying topoisomerase I which removes negative superhelical turns from DNA. In the absence of this enzyme, transcription of the DNA is increased. It is proposed that the exaggerated shutoff of respiration and increased killing of supX cells occurs because of the greater ease of transcription of an operon involved in UV-induced respiration shutoff.

27184 Natural chelates for radionuclide decorporation. Premuzic, E.T. (to Dept. of Energy). US Patent Application 6-526,246. 25 Aug 1983. 27p. Contract AC02-76CH00016.

Portions are illegible in microfiche products.

This invention relates to the method and resulting chelates of desorbing a radionuclide selected from thorium, uranium, and plutonium containing cultures in a bioavailable form involving pseudomonas or other microorganisms. A preferred microorganism is Pseudomonas aeruginosa which forms multiple chelates with thorium in the range of molecular weight 1000 to 1000 and also forms chelates with uranium of molecular weight in the area of 100 to 1000 and 1000 to 2000.

27185 The shapes of the radiation dose-mutation response curves in drosophila: Mechanisms and implications. Abrahamson, S.; DeJongh, C.; Meyer, H.U. (Dept. of Zoology, Univ. of Wisconsin, Madison, WI). pp 477-496 of Measurement of risks. Berg, G.G. New York, NY; Plenum Publishing Corp. (1981). (CONF-800601—).

From 13. Rochester international conference on environmental toxicity--measurement of risks; Rochester, NY, USA (2 Jun 1980).

This chapter proposes that radiation induced mutations, namely sex-linked recessive lethals in Drosophila and forward mutations at specific loci in Drosophila, mammals and lower eucaryotes, are the result of two sub-lesions or hits, induced by either single ionization tracks or by the interaction of two independent tracks for low LET radiations, when the dose is delivered in an acute fashion. Utilizes the well recognized linear quadratic expression $Y=C+\alpha D+\beta D^2$, where C is the spontaneous frequency of events scored and α and β represent the coefficients of the dose. Concludes that for low LET radiations, X or gamma rays, the linear-quadratic model can be used to predict the genetic response of germ cells and somatic cells to a variety of radiation regimes. Points out that the point of inflection in the curve, α/β value, can be determined specifically by target dimensions which vary with respect to DNA content. Considers the difference in RBE values observed for different species to be a reflection of their different target sizes.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 27076, 27161

27186 (CONF-811048—Summs.) International symposium on indoor air pollution, health and energy conservation. Extended summaries. (Harvard Univ., Cambridge, MA (USA)). 1981. 531p. NTIS, PC A23/MF A01; 1; GPO Dep. Order Number DE84004447.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

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A collection of extended summaries prepared by the participants of the International Symposium on Indoor Air Pollution, Health and Energy Conservation held October 13 to 16, 1981 at the University of Massachusetts. The converence was divided into sections with papers addressing the characterization of the indoor environment, characterization of formaldehyde and other organic pollutants in the indoor environment, health effects of indoor pollutants, characterization of aerosols and inorganic gases in indoor environment, energy conservation and indoor air quality, ventilation and controls, exposure studies, models for indoor air quality and energy conservation, and policy and regulatory issues. (DT)

27187 Comparative temperature-dependent growth rates of largemouth and smallmouth bass fry. Coutant, C.C.; DeAngelis, D.L. (Oak Ridge National Lab., TN). *Transactions of the American Fisheries Society;* **112**: 416-423(1983). Contract W-7405-ENG-36.

First-month growth was temperture-dependent for fry of largemouth bass Micropterus salmoides and smallmouth bass M. dolomieui that were raised simultaneously under identical conditions. Similar temperatures (25-27 C) produced the fastest growth rates in both species, although largemouth bass grew most rapidly at the higher end of this range. Largemouth bass generally grew faster than smallmouth bass, particularly in 25 to 20 C range (average 1.4 times). Variance about the mean standard length increased at higher temperatures. Differing temperature-dependent growth rates and size distributions for the two species may influence their relative abilities to survive predation and to form strong year classes in temperature regimes that differ due to latitude or weather.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 25245, 25292, 25700, 26574, 26931, 26954, 26955, 26956, 26977, 27110, 27186, 27186, 27226

27188 (CONF-811048—Summs., pp 5p, Paper 4) **Indoor climate problems in Danish dwellings. Complaints and diseases referred to the type and materials of dwellings and the use of airings.** Valbjorn, O.; Nielsen, P.A.; Kjmer, J. (Danish Building Research Inst., Horsholm, Denmark). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

This investigation deals with dwellings where the occupants presumed that their complaints about nuisances were related to the indoor climate. The persons involved can be defined as a sensitive

group, while as well headache and nuisances in the respiratory system are frequent. As the most common complaints of those related to the psysical climate by the persons spontaneously, i.e., headache and dry upper airways also can be psychosomatic reactions, future investigations on the complaints should incorporate the psychological and social aspects. (DT)

27189 (CONF-811048—Summs., pp 4p, Paper 31) **Environmental control of indoor air pollution with subsequent challenge testing in humans.** Rea, W.J. (Univ. of Texas Southwestern Medical School, Dallas); Smiley, R.E.; Sprague, D.E.; Edgar, R.T.; Fenyves, E.J.; Greenberg, M.; Johnson, A.R. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Patients, thought to be environmentally sensitive, were placed in a specially designed hospital environmental unit in order to reduce exposure to gaseous and particulate contaminants. These individuals were taken off all symptom-suppressing medication and food for four to seven days. Laboratory parameters such as eosinophils, total complement, gamma globulins and T lymphocytes were monitored during the time in the environmental unit. Besides noting the improvement of signs and symptoms, many of the laboratory tests were noted to return to control levels. (DT)

27190 (CONF-811048—Summs., pp 2p, Paper 32) **Lung collagen metabolism in rats exposed to nitrogen dioxide.** Last, J.A. (Univ. of California, Davis). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Collagen synthesis rates were determined in lung minces from rats exposed to 5 to 25 ppM of NO_2 for 1 week. The results gained suggest that inhaled NO_2 is fibrogenic but that 15 to 20 fold higher concentrations of NO_2 are required to produce the same degree of fibrogenesis as seen with ozone. Exposure of rats to ozone or to NO_2 gas in the presence of an aerosol of $(NH_4)_2SO_4$ particles, in the respirable size range, resulted in enhanced fibrogenic and toxic response of rat lungs to these gases. (DT)

27191 (CONF-811048—Summs., pp 3p, Paper 33) **Respiratory irritation due to carpet shampoos.** Kreiss, K.; Gonzalez, M.G.; Conright, K.L.; Scheere, A.R. (Colorado Health Dept., Denver). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

We report here a novel indoor air pollutant, residue from carpet shampoo, which caused outbreaks of mucous membrane irritation in an office building and in a day-care center. (DT)

27192 (CONF-811048—Summs., pp 4p, Paper 35) **Survey of indoor formaldehyde levels and apparent building-related illness in conventional housing in Delaware County, Indiana.** Godish, T.J. (Ball State Univ., Muncie, IN). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Measurable levels of formaldehyde were recorded in all homes investigated. Most complaint homes investigated indicated patterns of building-related illness. The frequency of the most reported symptoms closely reflect those observed in Wisconsin mobile home studies. However, formaldehyde levels reported here are on the average only a fraction of those reported for mobile homes. Although building-related illness was indicated in most homes investigated, a causal relationship with formaldehyde contamination has yet to be determined. (DT)

27193 (CONF-811048—Summs., pp 3p, Paper 36) **Irritant symptomatology, clinical observations and formaldehyde exposure among Wisconsin mobile home residents.** Anderson, H.A.; Hanrahan, L.P.; Dally, K.A.; Rankin, J. (Univ. of Wisconsin, Madison). 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Mobile homes, which utilize a higher proportion of urea formaldehyde resin containing construction materials and home furnishings than conventional homes have been disproportionately represented among complaints received by the Wisconsin Division of Health form home owners concerned about mucous membrane irritation symptomatology. Significant concentrations of formaldehyde were found in many of these homes, several homes exceeding the OSHA occupational standard of 3.0 ppM. Observed formaldehyde concentration was positively associated with an increasing prevalence of irritant symptoms, especially those of the eyes, and was negatively correlated with the age of the home. (DT)

27194 (CONF-811048—Summs., pp 6p, Paper 37) **Multivariate analysis of health effects in a cohort of mobile home residents exposed to formaldehyde.** Hanrahan, L.P. (Wisconsin Div. of Health, Madison); Anderson, H.A.; Dally, K.A.; Eckmann, A.D.; Kanarek, M.S. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

The Wisconsin Division of Health has investigated 100 health complaints reported by mobile home occupants, along with a pilot randomly selected group of 65 mobile homes. A significant positive relationship was found between the log formaldehyde concentration in the home and the report of irritant symptomatology (i.e., eye irritation). (DT)

27195 (CONF-811048—Summs., pp 8p, Paper 38) **Health effects of indoor formaldehyde exposure.** Schenker, M.B.; Weiss, S.T. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Surveys of symptomatic subjects in homes with urea formaldehyde foam insulation (UFFI) have found most symptoms to involve the mucous membranes, respiratory tract, central nervous system or skin. We evaluated these systems in seventeen subjects from 4 homes with UFFI, self referred to an environmental health clinic. The study subjects did not demonstrate a significantly increased prevalence of lower respiratory tract symptoms. Baseline spirometry was normal in all subjects. Taken with the high prevalence of eye and throat irritation symptoms, these findings are consistent with the effects of a highly soluable irritant gas, affecting primarly the mucous membranes including the proximal airways. While memory storage deficits could not be demonstrated, 60% of the patients had either impaired span or capacity to sustain attention. This was associated with depression in six of the seven patients with elevated depression scores. These findings may be due to a generalized malaise that accompanies illness or to a physiological mechanism via alterations in neurotransmitters or other brain chemical. (DT)

27196 (CONF-811048—Summs., pp 3p, Paper 39) **Residential air quality measurements as a component of exposure assessment for a health effects study.** Stock, T.H. (Univ. of Texas Health Science Center, Houston); Kotchmar, D.J.; Holguin, A.H.; Buffler, P.A. 1981. NTIS, PC A23/MF A01.

From International symposium on indoor air pollution, health and energy conservation; Amherst, MA, USA (13 Oct 1981).

Two residential clusters of asthmatics in the Houston area are currently (May to October, 1981) being studied as part of an overall attempt to assess the health effects of air pollution in the Texas Gulf Coast area. Respiratory health status of each of the study participants is evaluated by means of several daily self-administered pulmonary function measurements and the recording of subjective symptomatology, medication use, and activity on personal daily log forms. Corresponding air pollutant exposure data are produced by continuously monitoring data from centrally-located fixed stations, residential indoor/outdoor measurements, and personal monitoring. (DT)

27197 **(CONF-7803144—1) Quantifying smoke hazards.** Martin, S.B.; McKee, R.G. (SRI International, Menlo Park, CA (USA)). 1978. 45p. NTIS, PC A03/MF A01. Order Number DE84900943.

From Joint meeting of Society of Plastics Engineers and the Fire Retardant Chemicals Association; Houston, TX, USA (12 Mar 1978).

A rationale is provided for the establishment of a bioassay protocol that properly accounts for the fire-related qualities of smoke toxicity. This paper summarizes test data selected to validate the methodology. From data records for test materials, and a similar set for carbon monoxide alone, values of tau and EC_{50} are read and 3 values are computed for incapacitation (50% deficit in avoidance and escape behavior) and lethality (50% loss of life in both shock motivated and quiescent animals). 17 references, 9 figures, 5 tables.

27198 **(LA-UR—84-1284) Molecular response of cadmium resistant Datura innoxia cells to heavy metal stress.** Jackson, P.J.; Naranjo, C.M.; McClure, P.R.; Roth, E.J. (Los Alamos National Lab., NM (USA); Utah Univ., Salt Lake City (USA). Dept. of Biology). 16 Apr 1984. Contract W-7405-ENG-36. 17p. (CONF-8404139—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84011339.

From Solar central receiver annual meeting; San Diego, CA, USA (24 Apr 1984).

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Datura innoxia suspension culture cells can be selected for the ability to grow rapidly for extended periods of time in normally toxic concentrations of cadmium ion. Resistance to this toxic heavy metal is correlated with the ability to rapidly synthesize large amounts of one or more low molecular weight, cysteine-rich, metal binding proteins. Resistance to increasing concentrations of cadmium is correlated with both the rate of de novo synthesis and the maximum accumulation of these binding proteins within cadmium resistant cells. The ability of one metal binding protein to tightly bind copper ion suggests that these proteins may normally play a role in trace metal metabolism and transport. Metal binding proteins are not easily detectable in the cadmium sensitive cells from which resistant cells were derived. 22 references, 8 figures.

27199 (LBL—13500, pp 3.15-3.17) **Pollutant emission rates from indoor combustion appliances and sidestream cigarette smoke.** Girman, J.R.; Allen, J.R.; Apte, M.G.; Hollowell, C.D.; Martin, V.M.; Traynor, G.W. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Calculating emission rates of these combustion-generated pollutants is an essential step in assessing the degree to which these pollutant sources affect indoor air quality. In this paper, we report the pollutant emission rates derived from our studies of a gas-fired stove, gas-fired unvented space heater, kerosene-fired unvented space heater, and sidestream cigarette smoke. These experiments were carried out in an environmental chamber under controlled ventilation, and our Mobile Atmospheric Research Laboratory was used to measure gas-phase pollutant concentrations.

27200 (LBL—13500, pp 4.122-4.123) **Asymmetry of the mitochondrial membrane.** Mehlhorn, R.J.; Packer, L. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

Mitochondria were found to be unduly permeable to charge spin probes and other paramegnetic ions for routine studies. We therefore made preliminary studies with light-activated membrane systems which offered the opportunity to examine very rapid responses of spin probes to energy gradients.

27201 **(NP—4770236) Environmental research in forest damage.** Riesenhuber, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 15 Aug 1983. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84770236.

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Co-ordinated fighting of forest damage by science and technology and relative legislative measures belong to the foremost aims of the federal government. The damaging effects of air pollutions result predominantly from locally differentiated influences of "acid depositions" and direct influences. As yet it is not possible to verify the various hypotheses on cause-effect relationships experimentally. The question around which the efforts are centered is, what can be done to mitigate or avoid damage in addition to the reduction of pollutants emitted.

27202 **(NP—4770241) Cadmium load of the population in the over 50 age group in the South Bavarian region.** Renjut, A. (Muenchen Univ. (Germany, F.R.). Fachbereich Medizin). 1982. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84770241.

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Liver and kidney tissue samples were collected from 103 people in the age range 51 to 90 from 1980 to 1981. Following wet maceration they were analysed for Cd-content using atomic absorption spectrometry. Mean values for Cd-concentration in the liver and kidney were 1.27 $\mu g/g$ and 41.05 $\mu g/g$ respectively. A statistically significant reduction in Cd-content with age in liver and kidney of persons over 50 was established. Higher Cd-values in both liver and kidneys were found in samples taken from people living in towns than in rural districts. Mean values for Cd-concentration in the liver of smokers (anti $x=1.33$ $\mu g/g$) were not significantly different from those of non-smokers (anti $x=0.96$ $\mu g/g$), whereas in the kidneys significantly higher values for smokers (anti $x=62.53$ $\mu g/g$) compared to non-smokers (anti $x=31.33$ $\mu g/g$) were obtained. The mean values for Cd-concentration of persons with cirrhosis of the liver or fatty livers were markedly lower than those for persons with other liver complaints or for those without liver damage.

27203 **(PNL—4614-Vol.2) Field evaluation of hazardous waste site bioassessment protocols. Volume 2.** Thomas, J.M.; Cline, J.F.; Gano, K.A.; McShane, M.C.; Rogers, J.E.; Rogers, L.E.; Simpson, J.C.; Skalski, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010763.

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The overall goal of the plan was to demonstrate that honeybees could be used in detecting likely areas of chemical pollution, to demonstrate the usefulness of microbial and plant phytoassays, and to demonstrate a relationship between laboratory derived phytotoxicity results and field observations of plant community structure and diversity. Field studies were conducted through a cooperative arrangement with the US Army arsenal in Commerce City, Colorado.

27204 **(UCID—20030) Documentation of trichloroethylene for the material safety data sheet.** Fields, B.C.; MacDonald, L. (Lawrence Livermore National Lab., CA (USA)). 15 Apr 1984. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010922.

An investigation was made of all available research data to evaluate and determine the toxic effects of trichloroethylene (TCE) for the Material Safety Data Sheet. It is a study of the toxic effects on humans and animals of exposure to various concentrations of TCE. The study, which includes chronic exposure to TCE causing damage to the skin, eyes, and all internal vital organs, was made in order to establish safe levels, or further lower exposure levels, in the interest of biological safety. 35 references, 1 table.

27205 **Sulfur dioxide and ammonium sulfate effects on pulmonary function and bronchial reactivity in human subjects.** Kulle, T.J.; Sauder, L.R.; Shanty, F.; Kerr, H.D.; Farrell, B.P.; Miller, W.R.; Milman, J.H. (Univ. of Maryland, Baltimore). *American Industrial Hygiene Association Journal;* **45**: No. 3, 156-161(Mar 1984). Contract AS05-81EV10586.

The effect of exposures to 1 ppm sulfur dioxide (SO_2) and 500 $\mu g/m^3$ respirable ammonium sulfate $[(NH_4)_2SO_4]$ was studied in 20 nonsmoking subjects to determine if a response can be measured at these atmospheric levels and if the response is additive or synergistic. Four-hour separate and combined exposures were employed. Each subject acted as his or her own control and performed two light-to-moderate exercise stints (612 kg-m/min) for 15 minutes on each day's confinement in the environmental chamber. Pulmonary function tests (body plethysmography and spirometry) and bronchi-

al reactivity to methacholine were performed to assess the response of these exposures. No significant changes in pulmonary function or bronchial reactivity were observed in the individual exposures [$(NH_4)_2SO_4$ or SO_3], the combined exposure [$(NH_4)_2SO_4$ and SO_3], or 24 hours post-exposure. This study design and the observed results did not demonstrate any readily apparent risk to healthy subjects with these exposures. Since no significant changes were measured, it was not possible to conclude if these two pollutants in combination produce an additive or synergistic response.

27206 **Carcinogenicity of single and multiple intratracheal instillations of cadmium oxide in the rat.** Sanders, C.L.; Mahaffey, J.A. (Pacific Northwest Lab., Richland, WA). *Environmental Research;* **33**: No. 1, 227-233(Feb 1984). Contract AC06-76RL01830.

The carcinogenic effects of single or multiple exposures to intratracheally instilled cadmium oxide, resulting in total doses of 0, 25, 50, and 75 μg, were studied in groups of 41 to 48 male Fischer rats. Pulmonary-deposited cadmium oxide did not result in increased numbers of tumors, except in the mammary gland or in rats that had three or more tumor types. Cadmium oxide was not carcinogenic in the lung, liver, kidney, or prostate gland of rats.

27207 **Dose-response analysis of cadmium in man: body burden vs kidney dysfunction.** Ellis, K.J.; Yuen, K.; Yasumura, S.; Cohn, S.H. (Brookhaven National Lab., Upton, NY). *Environmental Research;* **33**: No. 1, 216-226(Feb 1984). Contract AC02-76CH00016.

The primary objective of this study was to develop dose-response relationships of cadmium in human beings. In vivo measurements of kidney, liver, urine, and blood cadmium, and urinary levels of β_2-microglobulin and total protein were obtained in 82 industrially exposed workers and 30 control subjects. The values of 200 μg/g creatinine for urinary β_2-microglobulin and 250 mg/g creatinine for urinary total protein were used to define the upper limit for normal kidney function. Forty-one of the cadmium workers (18 active, 23 retired) were classified as having abnormal kidney function; all control subjects had normal kidney function. Most workers with Cd above 70 ppm in the liver were judged to have some evidence of kidney abnormalities. The dose-response relationship for liver cadmium for the actively employed workers could be described by a linear logistic regression model: $\ln p/(1-p) = 0.118 \times$ liver cadmium (ppm) - 5.00 where p is the individual's probability of having kidney dysfunction. The loss of cadmium from the kidney following dysfunction prohibited a direct logistic analysis of the kidney cadmium data. However, when the linear relationship between kidney and liver cadmium for the subjects with normal kidney function was combined with the logistic equation for the liver, a predicted-response curve was obtained for the kidney. The logistic models predict a 50% probability of having kidney dysfunction at 38.4 mg for the kidney and 42.3 ppm for the liver, respectively.

27208 **Population biology in the courtroom: the Hudson River controversy.** Barnthouse, L.W.; Boreman, J.; Christensen, S.W.; Goodyear, C.P.; Van Winkle, W.; Vaughan, D.S. (Oak Ridge National Lab., TN). *BioScience;* **34**: No. 1, 14-19(Jan 1984). Contract W-7405-ENG-26.

In support of more than a decade of litigation, scientists devoted unprecedented effort to modeling the impact of electric power generation on the Hudson River striped bass population. When the Cornwall pumped storage facility was first proposed, opponents of the project argued that enormous numbers of striped bass eggs and larvae would be entrained with the pumped water and killed. Several years later, when the US Atomic Energy Commission held hearings to investigate the potential environmental impacts of Indian Point Unit 2, a nuclear power plant nearing completion 25 km downriver from Cornwall, it was argued that young striped bass would be entrained through the condensers with the cooling water and killed by thermal and mechanical stress. In addition, fish would be killed by impingement on the trash screens. The AEC staff recommended that a cooling tower be built at Indian Point to reduce cooling-water requirements and, therefore, entrainment and impingement mortality. The most sophisticated models failed to provide useful long-term impact predictions. However, simpler models, used to evaluate alternatives for mitigation, were instrumental in arranging a negotiated settlement.

27209 **Comparative toxicities of coal- and shale-derived crude oils and a petroleum-derived fuel oil to the fresh water snails Helisoma trivolvis and Physa gyrina.** Millemann, R.E.; Tumminia, S.J.; Forte, J.L.; Daniels, K.L. (Oak Ridge National Lab., TN). *Environmental Pollution, Series A: Ecological and Biological;* **33**: No. 1, 23-38(1984). Contract W-7405-ENG-26.

The water-soluble fractions (WSFs) of coal- and shale-derived crude oils and a No. 2 diesel fuel oil were tested for acute and chronic toxicity to the pulmonate snails Physa gyrina and Helisoma trivolvis. The 48-h HC_{50}s (WSF dilutions that killed 50% of the animals in 48h) of coal oil WSF and shale oil WSF for adult H. trivolvis were 5.4% and 16%, respectively, and for adult P. gyrina they were 3% and 3.6%. Full-strength diesel fuel oil WSF did not kill adult snails of either species in 48h. In the chronic toxicity tests, snail embryos were exposed continuously to sublethal WSF concentrations from the time of oviposition through 1 week post hatching (11-23 days). The lowest concentrations of coal oil, shale oil and diesel fuel oil WSFs that significantly reduced hatching of H. trivolvis were 0.125%, 0.5% and 32%, respectively, and for P. gyrina they were 1.1%, 2.5% and 8%. Some of the high WSF concentrations significantly delayed hatching of both snail species by about 2 days as compared with the controls. There were no effects of the WSFs on survival of hatched snails. The data suggest that the WSFs may be teratogenic for snail embryos.

27210 **Effects of a synthetic crude oil on pond benthic insects.** Cushman, R.M.; Goyert, J.C. (Oak Ridge National Lab., TN). *Environmental Pollution;* **33**: No. 1, 163-186(1984). Contract W-7405-ENG-26.

The effects on pond benthic insects of a synthetic (coal-derived) crude oil at doses equivalent to 375, 75 and 15 ml oil m^{-3} pond water was described. Total insect abundance and abundance by taxon, total biomass and biomass by taxon, number of taxa, and aspecies diversity based on abundance and biomass were all used as measures of community-level stress. The highest dose caused immediate and drastic effects, evident in all indices of stress. These effects were observed at concentrations of total phenols and oil:water ratios lower than those found to be toxic in laboratory acute bioassays. Populations of the midge Chironomus decorus in one of the medium dose ponds were stimulated, apparently an indirect effect of toxicity of the oil to the macrophyte Elodea canadensis. Three months after the dosing, there was some recovery of the pond insects, even at the highest doses examined. In comparison with indices based solely on numerical abundance, indices of stress incorporating data on biomass of individual organisms did not add appreciably to the understanding of effects.

27211 **Persistence and transfer of ^{36}Cl-DDT in the soil and biota of an old-field ecosystem: a six-year balance study.** Forsyth, D.J.; Peterle, T.J.; Bandy, L.W. (Ohio State Univ., Columbus). *Ecology;* **64**: No. 6, 1620-1636(Dec 1983).

The fate of a 1 kg/ha application of granular chlorine-36-labeled DDT made by helicopter on 10 June 1969 to a 4-ha old-field study area near Urbana, Ohio was traced and quantified in soil and biota through November 1974. Between 1970 and 1974, residues of DDT (DDTR, includes DDT plus metabolites) declined from 22.0 to 3.8 mg/kg tissue in earthworms (Lumbricus terrestris) and from 9.3 to 2.1 mg/kg in slugs (Deroceras laeve). Levels of DDTR in foliage of grasses and forbs increased from 2-3 mg/kg in 1970 to 7.6 mg/kg in 1974, but remained relatively constant at 1.6 mg/kg in roots. Amounts of residues in samples of air collected at the surface of the soil were positively correlated with amounts in soil and with air temperature. The total quantity of DDTR in the top 12 cm of soil was estimated to be 1779 g in October 1974, or 38% of the amount applied in 1969. Earthworms, which comprised the largest component of animal biomass, contained 5% of the total DDTR in the ecosystem in 1969, compared to 3% in the plants and other biota. As residues declined in earthworms and increased in plants over time, the total DDTR bound in the biota increased until it accounted for 22% of the total DDTR in the ecosystem in 1974. Losses of DDTR from the ecosystem each year were attributed primarily to volatilization from soil, because losses in runoff and emigrating insects and small mammals were negligible. 12 references, 7 figures, 6 tables.

27212 Health effects of air pollution due to coal combustion in the Chestnut Ridge Region of Pennsylvania: results of cross-sectional analysis in adults. Schenker, M.B.; Speizer, F.E.; Samet, J.M.; Gruhl, J.; Batterman, S. (Harvard Medical School, Boston, MA). *Archives of Environmental Health;* **38**: No. 6, 325-330(Nov-Dec 1983).

Respiratory questionnaires (ATS-DLD-78) were administered to 5557 adult women in a rural area of Western Pennsylvania to evaluate the health effects of air pollution resulting from coal combustion. Air pollution data were derived from 17 air quality monitor sites and stratified to define low, medium, and high pollution areas. The means of 4 yr (1975-1978) annual averages for sulfur dioxide in each strata were 62, 66, and 99 $\mu g/m^3$, respectively. Total suspended particulates were not tested as a risk factor because they reflected air pollution from sources other than coal combustion (e.g., agricultural, road dusts). Risks of respiratory symptoms were evaluated in a multiple logistic model that adjusted for several potential confounding factors. The risk of wheeze most days or nights in nonsmokers residing in the high and medium pollution areas was 1.58 and 1.26, respectively, relative to residents in the low pollution area. In the subject of residents who had lived in the same location for at least 5 yr, relative risks increased to 1.95 and 1.40, respectively. An increased risk of grade 3 dyspnea in nonsmokers was associated with sulfur dioxide but did not achieve statistical signficance, and there was no association of cough or phlegm and air pollution in nonsmokers. Cigarette smoking characteristics were the major determinant of respiratory symptoms in smokers, and no independent association of air pollution was found. This study suggests that wheezing may be associated with ambient exposure to sulfur dioxide in nonsmokers, but no effect of sulfur dioxide on cigarette smokers was observed. Chronic cough and phlegm production were not associated with sulfur dioxide at the concentrations observed in this study.

27213 Distribution and elimination of inhaled phenanthridone in Fischer-344 rats. Dutcher, J.S.; Mitchell, C.E. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Journal of Toxicology and Environmental Health;* **12**: No. 4-6, 709-719(Oct-Dec 1983). Contract AC04-76EV01013.

Rats were exposed nose-only to an aerosol of [^{14}C] phenanthridone, a mutagenic aza-arene found in coal tar. Tissues, urine, feces, and expired air were collected at specified times and assayed for radioactivity. Radioactivity was rapidly absorbed from the respiratory tract and distributed to all tissues examined. It was rapidly eliminated from tissues (< 80% in 12 h), being concentrated only in the large intestine at later timepoints. Excretion of radioactivity in both feces and urine was complete within 4 d. Virtually none of the dose was eliminated as [^{14}C]CO_2. [^{14}C] Phenanthridone was also administered orally to assess its absorption from the gastrointestinal tract. Absorption was nearly complete (83 +/- 6%), indicating that phenanthridone ingested as a result of mucociliary clearance and swallowing, grooming, or coprophagy could also contribute to tissue exposure. These results are similar to those obtained from inhalation studies of other polycyclic aromatic hydrocarbons, indicating that as a class, inhaled polycyclic aromatic hydrocarbons may be rapidly absorbed from the respiratory tract, widely distributed throughout the body, and readily eliminated in both urine and feces.

27214 Preparation of oils for bacterial mutagenicity testing. Ma, C.Y.; Ho, C.; Quincy, R.B.; Guerin, M.R.; Rao, T.K.; Allen, B.E.; Epler, J.L. (Oak Ridge National Lab., TN). *Mutation Research;* **118**: 15-24(1983). Contract W-7405-ENG-26.

Four procedures used to prepare fossil-derived oils for bacterial mutagenicity testing have been examined. These are dewaxing by partitioning the oil between dimethyl sulfoxide (DMSO) and cyclohexane, incorporating a surfactant to increase compatability of the oil with the bioassay media, directly slurrying the oil in DMSO, and computing the mutagenicity of the oil by summing the contributions of individual chemical class fractions. DMSO slurries generally exhibit higher mutagenicities than computed by summing the contributions of chemical class fractions. Results of testing DMSO-slurries correlate ($r = 0.87$) well, however, with those obtained by summation. Mutagenicity results agree within a factor of two for the samples tested by 4 sample preparation procedures.

27215 Lichen communities on conifers in Southern California mountains: an ecological survey relative to oxidant air pollution. Sigal, L.L.; Nash, T.H. III. (Oak Ridge National Lab., TN). *Ecology;* **64**: No. 6, 1343-1354(1983). Contract W-7405-ENG-26.

In comparison with collections from the early 1900's when oxidant air pollution was essentially absent, 50% fewer lichen species were found on conifers during 3 yr (1976-1979) of collecting and sampling in the mountains of Southern California. Among the five mountain ranges studied, the San Bernardino Mountains, the region with the highest oxidant levels, had lower lichen frequency and cover values. Within the San Bernardino study sites, lichen cover was inversely related to estimated oxidant doses. Furthermore, at sites with high oxidant levels, marked morphological deterioration of the common species Hypogymnia enteromorpha was documented. Transplants of this species from the relatively unpolluted Cuyamaca Rancho State Park into the San Bernardino Mountains exhibited similar deterioration after a year's exposure. 4 figures, 9 tables.

27216 Photosynthetic recovery in Arctic caribou forage lichens following a long-term field sulfur dioxide fumigation. Moser, T.J.; Nash, T.H. III; Olafsen, A.G. (Arizona State Univ., Tempe). *Canadian Journal of Botany;* **61**: No. 1, 367-370(1983). Contract W-7405-ENG-36;AC06-76RL01830.

The gross photosynthetic response of Cladonia stellaris, cladonia rangiferina, and Cetraria cucullata was monitored during three growing seasons subsequent to a long-term, in situ SO_2 fumigation conducted in 1978 at Anaktuvuk Pass, AK. The lichen vegetation which had experienced the greatest SO_2stress during the 1978 fumigation remained photosynthetically inactive. Significant photosynthetic recovery was discovered in the test species which had experienced sublethal concentrations of SO_2; however, their photosynthetic capacities remained less than controls.

27217 Growth analysis of soybean exposed to simulated acid rain and gaseous air pollutants. Norby, R.J.; Luxmoore, R.J. (Oak Ridge National Lab., TN). *New Phytologist;* **95**: 277-287(1983). Contract W-7405-ENG-26.

Greenhouse-grown soybean plants were exposed to simulated acid rain (pH 2-6 to 5-6) and gaseous air pollutants ($SO_2 + O_3$) to determine how effects on short-term physiological processes are integrated into whole-plant response. Injury to expanding leaves, characterized by marginal necrosis and leaf deformation, was induced by twice-weekly exposure to simulated rain of pH 2-6 and to a lesser extent pH 3-4. Growth inhibition resulted only from exposure to rain of pH 2-6, and there were no significant pH x air pollution interactions. Growth analysis from periodic harvests indicated that inhibitory effects of rain of pH 2-6 were mediated through a reduction in leaf area ratio (LAR). The alteration in LAR was not attributable to reduced allocation of dry matter to leaves but to lower specific leaf area caused by leaf deformation. There were no effects of rain pH on unit leaf rate. A second experiment confirmed the lack of growth inhibition from simulated rain with pH>3-4. Cumulative water use, a measure that integrated aspects of root size, leaf area, and physiology, was remarkably similar in plants exposed to pH 3-4,4-2, or 5-6 simulated rain. These experiments suggest that vegetative growth of soybeans may be adversely affected by acid rain if pH is low enough to cause physical injury to leaves and loss of photosynthetic area.

27218 Delayed behavioral toxicity of lead with increasing exposure concentration. Cory-Slechta, D.A. (Univ. of Rochester School of Medicine and Dentistry, NY). *Toxicology and Applied Pharmacology;* **71**: 342-352(1983). Contract AC02-76EV03490.

Twenty-one day-old male Long-Evans hooded rats were exposed chronically to drinking solutions containing 500 ppm sodium acetate (controls) or 50, 100, or 500 ppm lead acetate. Performance on a fixed interval 1-min schedule of food reinforcement was assessed over 155 sessions. Blood lead values were monitored serially and brain lead determinations made at the end of testing (355 days of lead exposure). The lowest concentration of lead in the drinking water was associated with increases in the rate of fixed-interval responding over the first 30 sessions. At the two higher concentra-

tions, response rate values similar to controls over the first 40 sessions were followed by rate increases. The latency to maximum rate depended on concentration; the highest concentration was associated with the longest latency. Response rates of rats exposed to 50 ppm lead gradually returned to control levels after 120 sessions, while increased rates were sustained in rats at 100 and 500 ppm lead, even 100 days after lead exposure was terminated. Marked individual differences in susceptibility to lead-induced rate increases were observed in all treatment groups. Serial blood lead values were related both to exposure concentrations. Blood-brain ratios averaged 0.743 to 0.913, which agree with other data for the rat and human. These results confirm the vulnerability to lead of rats beyond the neonatal period, and extend the range of conditions under which such effects occur.

27219 **Somatosensory thresholds in monkeys exposed to acrylamide.** Maurissen, J.P.J.; Weiss, B.; Davis, H.T. (Univ. of Rochester School of Medicine and Dentistry, NY). *Toxicology and Applied Pharmacology;* **71**: 266-279(1983). Contract AC02-76EV03490.

Six monkeys were trained to report detection of a vibratory or electrical stimulus applied to the fingertip. The vibratory stimuli were presented at two frequencies (40 and 150 Hz). Thresholds were determined with a tracking procedure before, during, and after dosing. Each monkey served as its own control. Four monkeys were dosed orally with 10 mg/kg of acrylamide 5 days a week until the appearance of toxic signs. The total administered dose varied between 320 and 450 mg/kg. The other two monkeys served as time-matched controls. All the monkeys were observed 5 days a week. They were also weighed and presented with a visuomotor task twice a week. Weight loss usually preceded the onset of gross behavioral disturbances, such as loss of balance, tremor, or decreased activity. Impaired coordination, as revealed with the pickup test, paralleled weight loss. Electrical sensitivity was not affected. Vibration sensitivity, however, fell during dosing and remained impaired for several months after dosing ended. These data indicate that vibration sensitivity testing can trace the time course of intoxication and recovery in toxic peripheral neuropathies. Furthermore, the differential results obtained with vibratory and electrical stimulation are consonant with a primary effect on end-organ receptors.

27220 **Nondestructive X-ray fluorescence spectrometry for determination of trace elements along a single strand of hair.** Toribara, T.Y. (Univ. of Rochester School of Medicine and Dentistry, NY); Jackson, D.A.; French, W.R.; Thompson, A.C.; Jaklevic, J.M. *Analytical Chemistry;* **54**: No. 11, 1844-1849(Sep 1982). Contract AC02-76EV03490;AC03-76SF00098.

Concentrations of trace elements in hair are finding increasing value in nutritional studies (essential trace elements) and in toxicology (toxic metals). Previously available methods have been tedious, time-consuming, and expensive. A new development in X-ray fluorescence instrumentation that provides automatic longitudinal scanning for some 16 elements in consecutive hair segments is discussed. The mass (in $\mu g/mm$) is determined simultaneously at each point, and the absolute concentrations are computed in parts per million for the elements. The method is nondestructive, and results (including mass) show much reproducible detail. The millimeter by millimeter longitudinal analysis allows recapitulation for previous toxic metal exposures for months or years, depending upon the length of the hair strand. This instrument, in a clinical setting, opens up many new research opportunities.

27221 **Effects of simulated acidic rain on yields of Raphanus sativus, Lactuca sativa, Triticum aestivum and Medicago sativa.** Evans, L.S.; Gmur, N.F.; Mancini, D. (Brookhaven National Lab., Upton, NY). *Environmental and Experimental Botany;* **22**: No. 4, 445-453(1982). Contract AC02-76CH00016.

Experiments were performed to determine effects to simulated acidic rain on radishes (Raphanus sativus), lettuce (Lactuca sativa), wheat (Triticum aestivum) and alfalfa (Medicago sativa) grown under greenhouse conditions. Experimental designs allowed the detection of statistically significant differences among means that differed by less than 10%. Simulated rainfalls of 2.5, 25, 63, 398, 100 and 2512 $\mu eq\ H^+\ l^{-1}$ (pH 5.6, 4.6, 4.2, 3.4, 3.0 and 2.6, respectively) decreased root yields (fresh mass) of radishes 26, 42, 37, 41, 66 and 73% compared with plants not exposed to rainfalls, Similar reductions were present in radish shoot fresh mass, leaf area, and root diameter. Fresh mass yields of lettuce plants exposed to 100, 794 and 1995 $\mu eq\ H^+\ l^{-1}$ (pH 4.0, 3.1 and 2.7, respectively) were 11, 10 and 14%, respectively, below heads of plants not exposed to rainfalls. Yields of plants exposed to simulated rainfalls of 2.0 $\mu eq\ H^+\ l^{-1}$ (pH 5.7) were similar to plants not exposed to rainfalls. Although visible foliar injury occurred to lettuce, this injury was present only on wrapper leaves and would not affect marketable quality. Yields of wheat which were applied during anthesis and caryopsis development were not influenced by exposure to 46 simulated rainfalls even as high as 1996 $\mu eq\ H^+\ l^{-1}$ (pH 2.7). Alfalfa plants exhibited no overall differences in fresh mass of forage among treatments even after 57 simulated rainfalls of 1996 $\mu eq\ H^+\ l^{-1}$ (pH 2.7) over 105 days. 22 references, 2 figures, 7 tables.

27222 **The risks of measuring risk.** Berg, G.G. (Dept. of Radiation Biology and Biophysics, Univ. of Rochester School of Medicine and Dentistry Rochester, NY 14642). pp 3-8 of Measurement of risks. Berg, G.G.; Maillie, H.D. New York, NY; Plenum Publishing Corp. (1981). (CONF-800601—). Contract AC02-76EV03490.

From 13. Rochester international conference on environmental toxicity--measurement of risks; Rochester, NY, USA (2 Jun 1980).

This chapter summarizes the proceedings of the Thirteenth Rochester International Conference on Environmental Toxicity, which examined both the logical soundness of the inference of risk and the validity of the experimental evidence of damage. Topics include the statistical inference of risks; risks of prenatal exposures; risks of contaminated air and drinking water; comparative risks of energy sources; genetic and cancer hazards; and extrapolation to low doses. Discusses single factor models, population responses, conservative inferences, and linear extrapolation. Offers examples from current research by the participants on environmental hazards of toxic chemicals and ionizing radiation. Emphasizes the current trend in risk assessment and suggests alternative approaches.

27223 **Simulated deposition rates for SO_2 on a Southeastern US landscape.** Murphy, B.D.; Johnson, W.C.; Schlatter, E.C. (Oak Ridge National Lab., TN). *Agricultural Meteorology;* **21**: 179-193(1980).

Atmospheric transport and deposition of SO_2 are simulated over a circular area (22 km in radius) of representative landscape in East Tennessee. Data from aerial photographs were used to determine surface parameters which in turn allowed estimated deposition rates on the different ground cover types by taking account of both aerodynamic and surface related components of the process. Patterns of deposition rates are shown and are compared with spatial patterns of ground cover type. Area averaged values of deposition velocity are deduced for representative times of the year. The influence of various physical factors as they bear upon the perceived sensitivity of different species to SO_2 damage was speculated on.

27224 **Effects of SO_2 dosage kinetics and exposure frequency on photosynthesis and transpiration of kidney beans (Phaseolus vulgaris L.).** McLaughlin, S.B.; Shriner, D.S.; McConathy, R.K.; Mann, L.K. (Oak Ridge National Lab., TN). *Environmental and Experimental Botany;* **19**: 179-191(1979). Contract W-7405-ENG-26.

The effects of variations in SO_2 dosage kinetics on bean plants (Phaseolus vulgaris L. red kidney) were studied at SO_2 levels equal to or below the current secondary ambient air quality standard. Response of photosynthesis, transpiration and growth were measured to evaluate the extent and duration of effects following repeated treatment at weekly (Experiment I) and daily (Experiment II) intervals. Depression of photosynthesis was the most consistent response observed. Transpiration was either stimulated or depressed by SO_2 concentrations which reduced photosynthesis. This effect indicates a probable biochemical rather than stomatal basis for observed photosynthetic depressions noted in these experiments. Increasing the peak:mean concentration ratio from 1.0 to 1.7 during exposure had no obvious effect on short-term photosynthetic response but caused apparent stimulation of photosynthesis one day

later. Increasing the peak:mean ratio from 1.0 to 6.0 caused a threefold average greater depression of short-term photosynthetic response even though the 3 hr av. concentration was reduced by 25% (0.50-0.37). Residual effects from this treatment were generally small on the day after exposure. No strong evidence was obtained to indicate that plants were sensitized to SO_2-induced suppression of photosynthesis by previous exposure to SO_2. Predisposition was not apparent when exposures were repeated at weekly or daily intervals. Visible foliar injury did not occur. Analysis of harvest data at the end of these experiments indicated that plants could undergo a repeated short-term (1 day) cycle of photosynthetic inhibition and still retain an essentially unimpaired capacity for growth during a subsequent recovery period. When exposures were spaced a week apart, some indication of a residual effect on growth, particularly with the highest peak:mean ratio (6.0), was apparent. 26 references, 6 figures, 2 tables.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 25878, 26120

27225 **Influence of strong magnetic fields on genetic endpoints in Tradescantia tetrads and stamen hairs.** Baum, J.W.; Nauman, C.H. (Brookhaven National Lab., Upton, NY). *Environmental Mutagenesis;* 6: No. 1, 49-58(1984). Contract AC02-76CH00016.

Inflorescences from Tradescantia clones 4430 and 02 were subjected to mean magnetic field intensities of 0.16 or 0.76 to 0.78 tesla for 6 to 11 days. Following exposures to both intensities, damage to pollen mother cell chromosomes at early prophase was determined by scoring the frequency of micronuclei in early tetrads. Pink mutations in stamen hair cells of clone 4430 were scored for 15 days after a 6-day exposure to the higher intensity level while clone 02 was scored during and for 6 days after an 11-day exposure to the 0.16 tesla field. Comparison of micronuclei results from exposed groups to those for control groups that were scored concurrently showed that there was no significant difference in frequency for either clone or either field intensity (P values in contingency table analyses were between 0.42 and 0.6); similarly, pink mutation frequencies for clone 4430 exposed and control groups did not differ significantly (a contingency test yielded $chi^2 = 1.4$ and $P = 0.26$).

57 HEALTH AND SAFETY

27226 **(BNL—34597) Hazardous materials information hotline using System 2000.** Brower, J.E.; Fuchel, K. (Brookhaven National Lab., Upton, NY (USA)). 30 Apr 1984. Contract AC02-76CH00016. 13p. (CONF-8404120—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010791.

From Association of system 2000 users for technical exchange conference; Austin, TX, USA (30 Apr 1984).

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The Center for Assessment of Chemical and Physical Hazards (CACPH) at Brookhaven National Laboratory (BNL) has developed a computer hotline service for the Department of Energy (DOE) and its contractors. This service provides access to health and safety information for over 800 chemicals and hazardous materials. The data base uses System 2000 on a CDC 6600 and provides information on the chemical name and its synonyms, 17 categories of health and safety information, composition of chemical mixtures, categories of chemicals, use and hazards, and physical, chemical and toxicity attributes. In order to make this information available to people unfamiliar with System 2000, a user-friendly interface was developed using a Fortran PLEX Program. 1 reference, 1 figure.

27227 **(DOE/ER—0194) Health and environmental research. Summary of accomplishments.** (USDOE Office of Energy Research, Washington, DC). Apr 1984. 17p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010764.

This is a short account of a 40-year-old health and environmental research program performed in national laboratories, universities, and research institutes. Under the sponsorship of the federal agencies that were consecutively responsible for the national energy mission, this research program has contributed to the understanding of the human health and environmental effects of emerging energy technologies. In so doing, it has also evolved several nuclear techniques for the diagnosis and treatment of human ills. The form of this presentation is through examples of significant, tangible accomplishments in each of these areas at certain times to illustrate the role and impact of the research program. The narrative of this research program concludes with a perspective of its past and a prospectus on its future.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 25486, 25487

27228 (LBL—13500, pp 4.116-4.118) **Precise characterization of new world obsidian sources and the cost-effective determination of provenience of selected artifacts.** Stross, F.H.; Asaro, F.; Michel, H.V. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098.

In Energy and Environment Division, annual report, FY 1981.

A substantial portion of the work reported here concerned obsidian from the heartland of the Maya culture. Included are the large region often designated as Rio Pixcaya or San Martin Jilotepeque, northwest of Guatemala City, and some smaller source areas within a 50-mile radius of Guatemala City. Artifacts from two well-known sites, Tikal and Quirigua, both in guatemala, were analyzed by special techniques developed for their economy. Source investigations were also made of Ecuadorian obsidian, and artifacts from the Quito Valley were assigned to sources. Procedures also have been developed to intercalibrate analytical data published by other laboratories with our own when direct comparisons, for one reason or another, are not possible.

27229 **(NP—4770235) Warmwassersphaere - handling and processing of hydrographic data.** Sy, A. (Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde). 1983. 93p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84770235.

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This report reviews CTD data handling and the principle of processing for the profiling instrument 'Multisonde' as it is presently in use at the Institut fuer Meereskunde in Kiel, F.R.G., in the frame of the research programme 'Warmwassersphaere'. An introduction to the shipboard system of measuring and logging is given. An outline of both laboratory and in situ calibrations is presented. The main subject of this report is the processing of the data. Possible sources of errors in field measurements and their influence on data accuracy are discussed and the standard processing stages are described. A specific problem lies in data errors, which inhibit a routine processing. In order to edit these data a special filter, the median filter, is introduced. Its efficiency as well as the experiences gained through its practical application is described and discussed by means of comparison with conventional techniques. The data used for these tests were collected during the experiment Nordostatlantik '81.

27230 **Mixing rates in Shagawa Lake, Minnesota, sediments as determined from ^{106}Ru profiles.** Van Sickle, J. (Oregon State Univ., Corvallis (USA). School of Oceanography); Weimer, W.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)); Larsen, D.P. (Environmental Protection Agency, Corvallis, OR (USA). Corvallis Environmental Research Lab.). *Geochimica et Cosmochimica Acta;* 47: No. 12, 2189-2197(Dec 1983).

Rates of surficial sediment mixing and sediment burial are measured in Shagawa Lake, Minnesota, using radionuclide tracers. Based on ^{106}Ru profiles in 16 cores, mixing rates average 13 cm^2/yr within the upper 9 cm of sediment. Two other nuclides, ^{210}Pb and ^{137}Cs, provide further evidence for calculation of mixing rates. In addition, ^{210}Pb profiles estimate sediment burial rates (about 0.4 cm/yr). Mixing estimates are shown to be fairly insensitive both to

uncertainties in sediment burial rates and to temporal patterns of ^{106}Ru deposition.

5802 Geophysics

REFER ALSO TO CITATION(S) 25390, 25485, 25513, 25990

27231 (BMFT-FB-T—83-264) Interactive seismic interpretation system ISAS. Sattlegger, J.; Rosenbach, O. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1983. 62p. (In German). NTIS (US Sales Only), PC A04 MF/A01. Order Number DE84750926.

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Processing and interpretation of seismic data are well separated in most cases. Thus, results of interpretation relevant for processing may not be taken into account during processing. The objective of system ISAS is to perform the last important steps of processing at the time of interpretation and under control of the interpreter, interpretation taking place in the migrated domain. This makes it possible to optimize the result and to determine additional parameters such as seismic velocities. In order to achieve this migration before stack is performed in common offset planes taking account of refraction. The results of migration are stacked in various ways at the time of interpretation, the results being displayed on an interactive graphics terminal. Interpretation of interfaces and velocities takes place on the graphics terminal. The results of interpretation with ISAS are a migrated section, migrated before stack and taking account of refraction, along with the field of interval velocities.

27232 (LA—10033-PR) Earthquake catalog for northern New Mexico. Progress report, July-September 1983. Cash, D.J.; Olsen, K.H.; Stewart, J.N.; Wolff, J.J. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011008.

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This report is a summary of the earthquakes located in northern New Mexico by the Los Alamos National Laboratory seismic array. Data are presented in the form of tables and epicenter maps, with a brief explanatory text. 6 references, 4 figures, 2 tables.

27233 (NUREG/CR—3768) New Madrid seismotectonic study. Activities during fiscal year 1982. Buschbach, T.C. (Saint Louis Univ., MO (USA)). Apr 1984. 179p. NTIS, PC A09/MF A01 - GPO*. Order Number DE84901151.

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The New Madrid Seismotectonic Study is a coordinated program of geological, geophysical, and seismological investigations of the area within a 200-mile radius of New Madrid, Missouri. The study is designed to define the structural setting and tectonic history of the area in order to realistically evaluate earthquake risks in the siting of nuclear facilities. Fiscal year 1982 included geological and geophysical studies aimed at better definition of the east-west trending fault systems - the Rough Creek and Cottage Grove systems - and the northwest-trending Ste. Genevieve faulting. A prime objective was to determine the nature and history of faulting and to establish the relationship with that faulting and the northeast-trending faults of the Wabash Valley and New Madrid areas. 27 references, 61 figures.

27234 (NUREG/CR—3769) Description and significance of the gravity field in the Reelfoot Lake region of northwest Tennessee. Stearns, R.G.; Towe, S.K.; Hagee, V.L.; Nava, S.J.; Wilson, S.L. (Vanderbilt Univ., Nashville, TN (USA)). Apr 1984. 48p. NTIS, PC A03/MF A01 - GPO* $4.00. Order Number DE84901184.

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Gravity surveys at various levels of detail have been made at approximately 1200 stations in the Reelfoot Lake region of northwest Tennessee and adjacent portions of Missouri and Arkansas. Individual features were surveyed in detail. At Reelfoot Scarp, six lines of stations having a 100 to 500 foot spacing with close elevation control (+0.1 foot) were measured. Anomalies on these lines are caused by near-surface geology (faulting, clay-filled channel of abandoned course of Mississippi River). A survey of less accuracy discovered an anomaly along a fault at Henning in the Ripley South Quadrangle. In the Reelfoot Lake region the area of abundant earthquake occurrence is related to the gravity anomaly pattern. The earthquake area is sharply limited on the south by an abrupt change in anomaly trends, and the earthquakes diminish in number at a similar change in trend to the north. Some positive gravity anomalies appear to mark plutons where they coincide with positive magnetic anomalies. 13 references, 21 figures, 1 table.

27235 (USGS-OFR—82-893) Tilt measurements at Long Valley Caldera, California, May-August 1982. Dzurisin, D.; Cashman, K.; Sylvester, A.G. (Geological Survey, Vancouver, WA (USA). David A. Johnston Cascades Volcano Observatory; California Univ., Santa Barbara (USA). Dept. of Geological Sciences). 1982. 34p. NTIS, PC A03/MF A01. Order Number DE84900979.

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The Mammoth Lakes area in east-central California has experienced unusual seismicity and ground deformation since 1978, highlighted by four $M > 6$ earthquakes in May 1980 and by the discovery soon thereafter of a broad uplift within Long Valley caldera. Recurrent seismic swarms during June 1980-May 1982 raised concern over the possibility of renewed volcanic activity in the foreseeable future, prompting a USGS Notice of Potential Volcanic Hazard on 28 May 1982. As part of an intensified Long Valley monitoring effort sponsored by the USGS Volcanic Hazards program, a network of nine tilt sites was established near mammoth lakes in May and July 1982. This report describes those stations and presents results from three tilt resurveys during July-August 1982. 8 references, 10 figures, 8 tables.

27236 (USGS-OFR—83-326) Drilling report and core logs for the 1981 drilling of Kilauea Iki lava lake, Kilauea volcano, Hawaii, with comparative notes on earlier (1967-1979) drilling experiences. Helz, R.T.; Wright, T.L. (Geological Survey, Reston, VA (USA)). 1983. 68p. USGS-OFS, Box 25425-Denver Federal Center, Denver, CO 80225.

The purpose is: (1) to describe the 1981 drilling of Kilauea Iki lava lake, (2) to present the logs for the drill core recovered during the 1981 drilling, and (3) to present a summary of some of the field observations made during the 1967, 1975, 1976 and 1979 drillings that are relevant to the crystallization history of Kilauea Iki lava lake. This report supplements logs for the 1967-1979 core presented in Helz et al. (1980). 21 references, 4 figures, 4 tables.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 25338, 25339, 25345, 25346, 25347, 25348, 25506, 25521, 27236

27237 (LBL—17521) Cross-hole acoustic measurements in basalt. King, M.S.; Myer, L.R.; Rezowalli, J.J. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 12p. (CONF-840633—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010781.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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A series of cross-hole acoustic measurements have been performed in a columnar-jointed basaltic rock mass around an underground opening mined by the drill-and-blast method. The purposes of the test program were: to evaluate the rock mass characteristics around the opening; to determine the zone of blast damage; and to evaluate seismic methods for anomaly detection ahead of mining in this type of rock. The cross-hole measurements were made between four 76-mm diameter horizontal boreholes diamond-drilled 12 m into a wall of the underground opening. Repetitive pulses of compressional (P) and shear (S) waves of frequencies in the range 1 kHz to 100 kHz were propagated from a transmitter sonde through the rock mass to a receiver sonde, both of which were clamped hydraulically to the borehole wall. After amplification the received P- and S-wave signals were digitized at the surface by a digital oscillo-

scope and stored on floppy discs. The results indicate considerable reductions in P- and S-wave velocities at distances less than 2 m from the face. Beyond 2 m, the velocities in a vertical direction indicate almost constant values. The velocities in the horizontal direction beyond 2 m appeared erratic, but showed a general tendency to increase as a function of distance from the face. 19 references, 10 figures.

27238 **(UCRL—90234) Application of molecular dynamics to macroscopic particles.** Walton, O.R. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 13p. (CONF-830141—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011066.

From Workshop on media with microstructure and wave propagation; Houghton, MI, USA (24 Jan 1983).

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Molecular dynamics research is reviewed with emphasis on current nonequilibrium calculational techniques used to calculate transport coefficients in systems of polyatomic molecules. Many of the numerical methods and numerical-experiment evaluation techniques of that field could be adapted to macroscopic granular material studies. There are, however, significant differences between macroscopic and molecular interactions - differences that considerably modify some of the computational methods and also the interpretation of the calculational results. Macroscopic particles interact with nonconservative interaction forces. Macroscopically available energy is lost from the system during most dynamic interactions - through plastic deformation, friction and breakage. Cundall and Strack are using simplified models of the interaction forces acting between essentially rigid macroscopic particles to study quasi-static deformations in assemblies of two-dimensional circular particles. We are using somewhat similar two-dimensional models in a study of nonequilibrium shearing flow of granular materials. Several verification calculations and tests have confirmed the ability of these computer models to predict the dynamic interactions of macroscopic particles. Preliminary results from shearing flow calculations and corresponding laboratory tests are also in qualitative agreement. Plans for a quantitative study of shear stress dependence on shear rate and other parameters are discussed.

27239 **(UCRL—90257) Rapid technique for counting cracks in granitic rocks.** Durham, W.B.; Beiriger, J.M.; Weed, H.C. (Lawrence Livermore National Lab., CA (USA)). 23 Jan 1984. Contract W-7405-ENG-48. 28p. (CONF-8404131—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008801.

From Scanning electron microscopy conference; Philadelphia, PA, USA (15 Apr 1984).

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Using a scanning electron microscope and an image analyzer, we have developed a technique for counting and measuring cracks in rocks which is more efficient than traditional techniques in which an operator performs all image analysis functions. The key aspect of the technique is that black-on-white tracings of fresh cracks, which can be made rather quickly by an operator, are fed to an image analyzer which then digitizes and tabulates data. The most time-consuming step in the process has now become the generation of SEM micrographs and pertinent chemical (mineralogical) information, not the quantification of crack structure. The technique has been applied to two studies involving nuclear waste isolation in a granitic rock, Climax Stock (Nevada Test Site) quartz monzonite, a rock which is structurally very inhomogeneous. One study detected a relationship between crack structure and distance from a hammer-drilled borehole; the other study was unable to detect a relationship between crack structure and gamma irradiation treatment in rocks loaded to near failure. 12 references, 6 figures, 3 tables.

5804 Geochemistry

REFER ALSO TO CITATION(S) 25236, 26496, 27080

27240 (LBL—13500, pp 4.113-4.115) **Iridium anomaly approximately synchronous with terminal eocence extinctions.** Alverez, W.; Asaro, F.; Michel, H.V.; Alverez, L.W. Sep 1982. NTIS, PC A15/MF A01. Contract AC03-76SF00098. In Energy and Environment Division, annual report, FY 1981.

To determine whether the impact that produced the North American strewnfield also gave rise to an iridium anomaly, 30 elements were measured by high-precision techniques of neutron activation analysis in 9 samples from Deep Sea Drilling Project site 149 in the eastern Caribean. Conclusions are: (1) the association of iridium anomalies with major impact events, inferred for the Cretaceous-Teritiary boundary, is strengthened by recognition of an iridium anomaly at the microtektite horizon; (2) although not all impacts which produce detectable iridium enrichments are necessarily related to extinctions is strengthened by the synchronous disappearance of five species of radiolaria with the appearance of the irridium and microtektite anomalies near the Eocene-Oligocene boundary.

27241 **Phosphorus dynamics in a woodland stream ecosystem.** Newbold, J.D.; Elwood, J.W.; O'Neill, R.V.; Sheldon, A.L. (Oak Ridge National Lab., TN). *BioScience;* **34**: No. 1, 43-44(Jan 1984).

The term spiraling has been used to describe the combined processes of nutrient cycling and downstream transport in a stream ecosystem. The concept is used for describing and analyzing phosphorus dynamics in a 120-m reach of Walker Branch, a small woodland stream in Tennessee, during a period of summer base flow. A tracer of 10 mCi $^{32}PO_4$ was released to Walker Branch for 30 minutes after which measurements were made of the uptake of ^{32}P from water, coarse particulate matter, fine particulate matter, particulate organic matter, aufwuchs, grazers, shredders, collectors, net-spinning filter feeders and predators over a six-week period. The relatively short particulate and consumer turnover lengths in Walker Branch indicate that the overall rate of nutrient utilization would be relatively insensitive to changes in particulate transport rates or downstream drift rates. On the other hand, the long uptake length indicates that nutrient utilization would be strongly influenced by factors controlling the rate of phosphorus uptake from the water.

64 PHYSICS. I.

27242 **(LALP—84-18) Institutional supporting research highlights in physics and mathematics, fiscal year 1983.** Vigil, J.C. (comp.). (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011025.

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Highlights of FY 1983 Institutional Supporting Research and Development activities within the six Physics and Mathematics divisions and the Center for Nonlinear Studies are presented. The highlights are but a fraction of the ISRD activities in the Directorate and are intended to be a representative sample of progress in the various research areas. FY 1983 ISRD activities within the Physics and Mathematics divisions included both basic and applied research and were divided into 11 research areas: mathematics and numerical methods, low-energy nuclear physics, medium- and high-energy nuclear physics, atomic and molecular physics, solid-state physics and materials science, fluid dynamics, plasma physics and intense particle beam theory, astrophysics and space physics, particle transport methods, accelerator and fusion technology, and biophysics. Highlights from each of these areas are presented.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 27180

27243 **(EFI—591(78)-82) Theory of nonstationary long-term modulation of cosmic rays.** Bagdasaryan, M.B.; Dorman, L.I. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701407.

The nonstationary equation of diffusion with a moving boundary condition is solved, on the basis of which the effect of "stepwise" variations of solar activity, leading to "stepwise" vari-

ations of solar wind velocity and of transport length for scattering in the interplanetary space, on the intensity of galactic cosmic rays is investigated. Analytical solutions are obtained in the form of series by means of which one can estimate the dimensions of the modulation volume of 11-year variations.

27244 **(INIS-mf—8704) Anglo-Australian Telescope 1981/82.** (Anglo-Australian Telescope Board, Canberra (Australia)). 1982. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700886.

Operations of the Board for the period July 81 to June 82 are summarised. Major areas under study are galaxies, quasi-stellar objects, stars, supernova remnants and interstellar material. Research on dwarf novae, an infrared view of our galactic centre, the nucleus of the Seyfert galaxy NGC 1068, galaxies at great distances, the highest redshift quasar, the origin of quasar absorption lines and the unseen mass in our galaxy is briefly reported.

27245 **(LA-UR—84-919) Hugoniot of water ice.** Gaffney, E.S. (Los Alamos National Lab., NM (USA)). 19 Jan 1984. Contract W-7405-ENG-36. 52p. (CONF-840153—1). NTIS, PC A04; 3; GPO Dep. Order Number DE84010069.

From NATO workshop on ices in the solar system; Nice, France (16 Jan 1984).

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Hugoniot data for water ice are available for pressures ranging from about 150 MPa to about 50 GPa from initial states near 260 K. Limited data on porous ice (snow) at the same initial temperatures are available from 3.5 to 38 GPa and initial densities of 600 and 350 Mg/m^3. Above about 5 GPa, the data are fairly well-fit by a linear relation between shock and particle velocity: D(km/s) = 1.79 + 1.42u. However, a quadratic form fits the data better: $D(km/s) = 1.32 + 1.68u - 0.035u^3$. At lower stresses the velocity is a very complicated function of particle velocity due to elastic propagation, yielding and several possible phase changes. The Hugoniot elastic limit (HEL) of ice at these temperatures is about 180 +- 20 MPa with the elastic waves travelling at about 3900 m/s. The mean stress at the HEL is 115 +- 14 MPa. Comparison with strength measurements at lower strain rate indicates that failure at the HEL probably involves fracture and is almost independent of both temperature and strain rate. Ice V has been reported at about 600 MPa, and ice VI at 1.9 GPa and possibly at 3.7 GPa. Transition to ice III probably commences at the HEL at 200 MPa. Relations between volume, enthalpy and internal energy indicate that states below about 1 GPa maintain their shear strength even after undergoing complete transition to a high pressure phase. Time-resolved stress measurements indicate that equilibrium is achieved in about three microseconds for a 695 MPa shock. Melting is definitely complete below 10 GPa.

27246 **(RL—83-036) Numerical model of a solar flare based on electron beam heating of the chromosphere.** MacNeice, P.; Burgess, A.; Spicer, D.S.; McWhirter, R.W.P. (Scientific and Technical Studies, London (UK)). May 1983. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700887.

The hydrodynamic response of the solar atmosphere to the injection of an intense beam of electrons is calculated in a numerical simulation of a solar flare and the spectroscopic consequences of the hydrodynamic behaviour calculated are predicted by solving the equations of conservation of mass, momentum and energy. The latter is expressed as two temperature equations; one for the electrons and the other for the neutral atoms and positive ions of hydrogen. The equations are solved in one dimension and the geometric form is of a semi-circular loop having its ends in the photosphere. The results show how the loop is filled at supersonic speed with plasma at temperatures characteristic of flares. At the same time a compression wave is predicted to propagate down towards the photosphere. After the heating pulse stops, the plasma that has risen into the loop, starts to decay and return to the condition it was in before the pulse started. In predicting the spectrum that would be emitted by such a plasma calcium was chosen for illustration.

27247 **(UCID—20062) Cosmic bombardment.** Hyde, R.A. (Lawrence Livermore National Lab., CA (USA)). 19 Mar 1984. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011402.

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Throughout its history, the earth has been constantly bombarded by interplanetary bodies. In the maelstrom of the earth Solar System, such collisions created our planet and then fed its growth. With time, the rate of such collisions has dropped enormously, as most of the loose matter has been swept either up or out of the Solar System. However, because our planet has evolved and acquired an increasingly sophisticated biosphere, the significance of cosmic bombardment has not decreased. Cosmic bombardment kills; in the past, individuals, species, even entire branches of the evolutionary tree have been terminated by it. Unlike our predecessors, we have the ability to protect ourselves from this danger. To do this, we need a two-part system, featuring passive surveillance to identify threats, followed by an active defense to deflect or destroy incoming projectiles. We should first build a set of automated telescopes, using them to warn us of first-pass deadly comets and asteroids. As this surveillance continues, we will develop a catalog of the Apollo asteroids, enabling us to predict collisions with ever smaller asteroids many years in advance. Such anticipated threats can be dealt with leisurely; with neutron-rich bombs, such as presently exist, or with magnetic guns, which need not be developed until the requirement arises. Comets and small asteroids will not give us much warning; when the alarm sounds there will be no time for dithering. Hence, we should position a small number of interceptor rockets in earth orbit; their warheads can be kept on the ground and delivered to them as needed. These interceptors will destroy comets by impact detonation, and deflect small asteroids by neutron ablation.

27248 **Theoretical radial pulsation analyses of DA white dwarfs.** Starrfield, S. (Los Alamos National Lab., NM); Cox, A.N.; Hodson, S.W.; Clancy, S.P. *Astrophysical Journal;* **269**: 645-656(15 Jun 1983).

A linear, nonadiabatic, radial pulsation analysis of DA white dwarfs in the range of effective temperatures: $7 \times 10^3 < T/sub\ e/ < 1.25 \times 10^4$ K has been performed. The 0.6 M/sun mass/, 0.013 R/sub sun mass/ model envelopes consist of layers of pure hydrogen (masses of $\sim 10^{-15}$ M/sub star/ to $\sim 10^{-8}$ M/sub star/) overlying layers of pure helium and then pure carbons. The authors find that these envelopes are unstable to radial pulsations with periods less than 1.0s and that the cause of the instability is the k-mechanism operating in the hydrogen and the helium partial ionization regions. Convection is assumed to be frozen in so that it does not contribute to either driving or damping. The blue edge is at $\sim 1.23 \times 10^4$ K, and the red edge is $\sim 7 \times 10^3$ K. The most unstable modes exceed mode 20 (19 nodes). These results are in excellent agreement with other radial studies of DA white dwarfs and suggest that these oscillations should be observable in white dwarfs just to the blue and just to the red of the observational blue and red edges of the ZZ Ceti nonradial variables.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 26975

27249 **(LA—9648-MS) Evolution of structure in the PLACES barium clouds.** Simons, D.J.; Lebeda, C.F.; Pongratz, M.B.; Fitzgerald, T.J.; Dupre, R.R. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 181p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010996.

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The PLACES (Position Location and Communications Effects Simulations) experiment took place at Eglin Air force Base in December 1980. Los Alamos fielded intensified optical instruments to examine the barium ion and neutral resonance fluorescence light from the four barium ionospheric thermite releases. The primary purpose of the PLACES experiment was to determine the effects of structured ionospheric plasmas on transionospheric radio communi-

cation lines. As part of theis experiment, it was necessary to characterize the evolution of the structure (striations) in the barium ionospheric plasma. We examine the motivation for using barium to simulate these effects ad discuss the theoretical and empirical basis for using optical diagnostics for deriving the electron column content of the ion clouds. Data and derived column densities are presented for the PLACES GAIL and IRIS events as determined from the two camera stations. The time evolution of the power spectral density (PSD) of striations for the electron column density perpendicular to the magnetic field is derived for the two clouds. The power is integrated over several wavelength intervals to present the temporal behavior of spectral sums. Initial striation growth occurs in a broad band of spatial frequencies, which is in agreement with the linear gradient drift instability theory. Nonlinear evolution of the striations occurs in a few, well-separated spatial frequency modes. The equilibrium PSD shape seems to have power in many more modes than the initial nonlinear stage PSD. We find some quantitative indications of a forward cascade process.

27250 **(RL—83-027) Acceleration mechanisms for auroral particles: the observations, their current interpretation, and the need for a new approach.** Bryant, D.A. (Scientific and Technical Studies, London (UK)). Jun 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700923.

Experiments performed over the last 20 years have demonstrated that the electrons which produce the structured forms such as auroral arcs are accelerated en route from their source in the magnetosphere to the atmosphere. Evidence for this lies in the electron intensities being considerably higher than they are at the same energy in the source region of the plasma sheet. Electron velocity space densities are shown as a function of energy, measured at different times during a rocket flight through a stream of particles producing an auroral arc. The distributions, which have peaks at 3 keV and 10 keV, are typical of those found in this environment. They are sometimes described as being 'mono-energetic', but this does seem to overstate the case. The usual interpretation is that the peak is produced because the electrons have been accelerated through a potential difference. However, there are many features of the electron distributions and related quantities that appear to be inconsistent with this interpretation. It is the purpose of this paper to present each of these features, and to suggest that another type of process - resonant acceleration by plasma waves deserves careful consideration.

27251 **(RL—83-028) Acceleration of auroral electrons by waves.** Hall, D.S. (Scientific and Technical Studies, London (UK)). Jun 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700924.

The evolution of the auroral electron distribution function as the electrons traverse a region of plasma turbulence is discussed. Electron measurements are used to illustrate that if the energy densities of the waves associated with the turbulence are distributed in a particular way, various features of the electron distributions can be accounted for by changes in the details of the wave spectra without changes in the overall form.

27252 **(RL—83-029) Wave generation in the aurora.** Bingham, R.; Bryant, D.A.; Hall, D.S. (Scientific and Technical Studies, London (UK)). Jun 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700925.

Wave generation mechanisms by a number of free energy sources in the magnetosphere are discussed. These include the temperature difference between the plasma sheet and the tail lobes, the temperature anisotropy, and field aligned currents. It is shown that a number of wave-modes can be generated via a Weibel-type instability by the above free energy sources, also the production of Langmuir waves can be created by ion-acoustic turbulence. Various wave-particle interaction mechanisms are presented as possible processes for the production of high energy electrons which are responsible for the aurora.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 26392, 26510, 26800, 27461, 27461

27253 **(BNL—34477) Accelerator-based atomic physics experiments with photon and ion beams.** Johnson, B.M.; Jones, K.W.; Meron, M. (Brookhaven National Lab., Upton, NY (USA)). 26 Apr 1984. Contract AC02-76CH00016. 3p. (CONF-840481—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010789.

From Atomic physics program contractors workshop; Gaithersburg, MD, USA (26 Apr 1984).

Accelerator-based atomic physics experiments at Brookhaven presently use heavy-ion beams from the Dual MP Tandem Van de Graaff Accelerator Facility for atomic physics experiments of several types. Work is presently in progress to develop experiments which will use the intense photon beams which will be available in the near future from the ultraviolet (uv) and x-ray rings of the National Synchrotron Light Source (NSLS). Plans are described for experiments at the NSLS and an exciting development in instrumentation for heavy-ion experiments is summarized.

27254 **(CONF-840449—1) Resonance ionization spectroscopy measurement of the vapor pressure of several molecular species.** Capelle, G.A.; Jessup, D.A.; Borella, H.M.; Franks, L.A. (EG and G, Inc., Goleta, CA (USA). Energy Measurements Group). 1984. Contract AC08-83NV10282. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010656.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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In recent years resonance ionization spectroscopy (RIS) has found increasing application to various problems involving detection of low levels of atomic, and more recently molecular, species. This work demonstrates the usefulness of RIS in measuring vapor pressure curves of molecular species at very low pressures. Specifically, the vapor pressures versus temperature relationship for rubidium iodide (RbI) and potassium iodide (KI) was measured by applying RIS to atomic Rb and K, using a two-laser system. A pulsed molecular nitrogen laser first dissociated the RbI to produce ground-state Rb atoms in the experimental cell. A flashlamp-pumped dye laser then ionized the Rb in a process wherein two photons of the same wavelength are absorbed, the first exciting Rb via an allowed transition to an upper state ($5^2S/sub\ 1/2/ \rightarrow 6^2/sub\ 1/2$ or $3/2/$) lying in energy slightly more than half the distance to the ionization limit, and the second photon ionizing the excited Rb. In the case of KI, an excimer-laser-pumped dye laser was used in a similar way. An applied dc electric field swept the photoelectrons to a proportional counter for subsequent amplification and detection. The photoelectron signal was then related back to RbI and KI concentrations.

27255 **(CONF-840629—1) Photoelectron studies of excited molecular states: H_2C $^1/PI//sub\ u/$ and N_2O_3 $^1/PI//sub\ u/$.** Dehmer, J.L.; Dehmer, P.M.; Pratt, S.T. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006663.

From 13. international quantum electronics conference; Anaheim, CA, USA (18 Jun 1984).

Resonantly enhanced multiphoton ionization (REMPI) affords the opportunity to select a specific ionization pathway in order to produce a particular ionic state for further study (such as state-selected ion-molecule reactions) or to investigate detailed aspects of excited state photoionization dynamics. The production of electronic and vibrational state-selected ions has been achieved, and in some instances rotational state-selection may be possible. State-selected ions are obtained by first preparing an intermediate Rydberg state that has a potential energy curve similar to that of the desired final ionic state, and then ionizing the Rydberg state with a single additional photon. Under these circumstances, the Franck-Condon factors governing the final ionization step strongly favor the preservation of the vibrational level of the Rydberg state core. In addition, the photoionizing transition is expected to favor the

further excitation of the Rydberg electron, while retaining the electronic state of the ion core. Thus REMPI through a Rydberg state having an ion core in a particular vibronic state is expected to produce ions in the same vibronic state.

27256 **(FIAS-R—116) Electron coincidence spectroscopy - momentum space wave functions of electrons in atoms and molecules.** Weigold, E. (Flinders Univ. of South Australia, Bedford Park. Inst. for Atomic Studies). Aug 1983. 17p. (CONF-8306131—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700882.

From Asia Pacific Physics conference; Singapore, Singapore (12 Jun 1983).

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The application of electron coincidence spectroscopy to obtaining detailed information on the dynamic structure of atoms and molecules is discussed. The method gives electron separation energies and electron momentum distributions for each valence orbital (in the independent particle approximation). The sensitivity of the technique as a probe of electron wave functions (e.g. correlation effects) is discussed.

27257 **(GSI—83-37-Prepr.) Observation of a peak structure in positron spectra of U + Cm collisions.** Schweppe, J.; Gruppe, A.; Bethge, K.; Bokemeyer, H.; Cowan, T.; Folger, H.; Greenberg, J.S.; Grein, H.; Ito, S.; Schule, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751268.

A narrow peak structure has been observed in positron spectra from U+Cm collisions at bombarding energies near the Coulomb barrier whose origin cannot be associated with established dynamic mechanisms of positron production involving Rutherford trajectories only. The peak's energy is centered at 316+-10 keV. Its width of proportional 80 keV, dominated by Doppler broadening, implies that the emitting system exists for longer than proportional 10^{-20} sec.

27258 (INIS-SU—203, pp 46-48) **Radiation spectrum of superhigh energy positrons reflected from the solid surface.** Dyul'dya, S.V.; Nasonov, N.N.; Rozhkov, V.V.; Vit'ko, V.I.; Vojtsenya, A.V. 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

The spectral distribution of the energy emitted by superhigh energy positrons during their reflection at small angles from the solid surface (the reflection radiation) has been calculated. As the positron energy increases, the form of the reflection radiatian spectrum changes qualitatively as compared with the dipole case. At sufficiently high energies the radiation spectrum shows a characteristic maximum. The field of application of the obtained results is discussed. The spectral characteristics of the reflection radiation of superhigh energy positrons are compared to those of the synchrotron radiation.

27259 (INIS-SU—203, pp 49-57) **Electromagnetic radiation of relativistic positrons during a small-angle reflection from a solid surface.** Dyul'dya, S.V.; Nasonov, N.N.; Rozhkov, V.V.; Vit'ko, V.I.; Vojtsenya, A.V. 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01.

In Radiation damage physics and radiation technology.

Polarization- and spectral-angular characteristics of the electromagnetic radiation of ultrarelativistic positrons for the small-angle reflection from the solid surface have been calculated in the dipole approximation of classical electrodynamics. Studies have been made of the orientation effects in the radiation spectrum that are observed in the positron reflection from the monocrystal surface and are connected with the coherent interaction of the reflected particle with atomic chains on the crystal surface. Interference effects accompanying the multiple positron reflection from two parallel atomic planes have been considered.

27260 **(LA-UR—84-1235) Reactive resonances and angular distributions in the rotating linear model.** Hayes, E.F.; Walker, R.B. (National Science Foundation, Washington, DC (USA); Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 44p. (CONF-840415—20). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011354.

From 187. national meeting of the American Chemical Society; St. Louis, MO, USA (8 Apr 1984).

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This paper describes the way in which resonances in reactive scattering may affect the angular distribution of the products of reaction. A simple 3D model of reactions, the Bend-Corrected Rotating Linear Model was employed, and angular distributions were computed for several reactive systems in which resonances contribute to the scattering dynamics. The reactions studied were $F + H_2 \rightarrow HF + H$ and $He + H_2^+ \rightarrow HeH^+ + H$.

27261 **(NBS-LP—92-Suppl.4) Multiphoton bibliography, 1981-1982.** Eberly, J.H.; Piltch, N.D.; Gallagher, J.W. (eds.). (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA); Rochester Univ., NY (USA)). Jan 1984. Contract AS03-76DP01118. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010868.

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This bibliography is a continuation and expansion of a collection of references describing studies of the interaction of more than one photon with individual atoms and molecules in the gas phase. (GHT)

27262 **Semiclassical parametrization of the 6snh-6sni-6snk intervals in BaI.** Curtis, L.J.; Ramanujam, P.S.; Theodosiou, C.E. (Univ. of Toledo, OH). *Physical Review* [*Section*] *A: General Physics;* **28**: No. 2, 1151-1153(Aug 1983). Contract AS05-80ER10676.

A semiclassical core-polarization-penetration model is used to parametrize the 6snh-6sni and 6sni-6snk intervals in BaI which were recently measured by Gallagher, Kachru, and Tran. The parametrization represents the existing data to within experimental uncertainties, and extrapolative predictions along these Rydberg series are presented.

27263 **Excitation-autoionisation of Ti^{3+}, Zr^{3+} and Hf^{3+} in the distorted-wave approximation with exchange.** Bottcher, C. (Oak Ridge National Lab., TN); Griffin, D.C.; Pindzola, M.S. *Journal of Physics B: Atomic and Molecular Physics;* **16**: L65-L70(1983). Contract W-7405-ENG-26

Full distorted-wave calculations have been carried out on $Np^6nd \rightarrow np^5nd^2$ transitions to test the formalism for complex atomic configurations, and to provide a more meaningful comparison with experiment than was possible from earlier calculations. Agreement with experiment is certainly improved, but some discrepancies remain.

27264 **Comparison of radiationless decay processes in osmium and platinum porphyrins.** Ponterini, G.; Serpone, N.; Bergkamp, M.A.; Netzel, T.L. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **105**: 4639-4645(1983).

Two osmium porphyrin complexes, $Os(OEP)L_2$ [OEP = octaethylporphin, L = py(pyridine) or NO], and PtOEP were investigated by picosecond laser spectroscopy with use of a double-beam, mode-locked Nd:glass system delivering 6-ps (fwhm) pulses at 527 nm with 1-2mJ/pulse. Time-resolved excited-state spectra were recorded from the time of photoexcitation to 5 ns after photoexcitation. The initial excited state, S_1, decayed in $\leq$9 ps for the two osmium complexes and in $\leq$15 ps for the platinum porphyrin. A second excited state, T_1, lived for 1, 9, and >50 ns respectively for $Os(OEP)(py)_2$, $Os(OEP)(NO)_2$, and PtOEP. The ΔA spectra of the T_1 states of the osmium complexes were similar to those of previously reported (d/sub π/,π^*) states for $Os(OEP)(py)_2$ and (π,π^*) states for $Os(OEP)(NO)_2$. This finding supports prior assignments of these states on the basis of expected axial and equatorial backbonding of the osmium's d electrons. Additionally, a long-lived (tau

> 5 ns) photochemical product (probably a result of ligand loss) was found in the case of Os(OEP)(py)$_2$.

27265 **Diatomics-in-molecules approximation for Rydberg states of H_3.** Raynor, S.; Herschbach, D.R. (Harvard Univ., Cambridge, MA). *Journal of Physical Chemistry;* **86**: No. 7, 1214-1217(1982).

Electronic energies for excited Rydberg states of H_3 in D/sub 3h/ or C/sub 2nu/ nuclear configurations are calculated by use of the diatomics-in-molecules method and spline fits to accurate potential curves for 22 states of the H_2 molecule. Explicit formulas expressing the energy levels of H_3 for D/sub 3h/ configurations in terms of the H_2 potential curves are given for all states corresponding to two ground-state atoms in consort with a third atom excited to any s or p state. The available data permit evaluation of the elevels for all states involving 2s or 2p excitation or II-type 3p excitation, as well as a few higher excitation. The results agree well (within ~ 0.01 hartree) with ab initio calculations. 12 references, 2 figures, 3 tables.

27266 **Tunable atomic line molecular (TALM) spectrometer.** Hadeishi, T.; Koizumi, H.; McLaughlin, R.D.; Millaud, J.E. (Lawrence Berkeley Lab., CA). *Spectrochimica Acta, Part B: Atomic Spectroscopy;* **37B**: No. 6, 501-509(1982).

A highly specific technique for real time monitoring of simple and complex molecules is described. This technique depends on using the Zeeman effect to tune an atomic emission line to coincide with a sharp molecular absorption feature and has been named TALMS (Tunable Atomic Line Molecular Spectroscopy). Results are presented on the determination of di-atomic (NO), tri-atomic (NO_2, SO_2), tetra-atomic (H_2CO) and more complex molecules, which suggests that the method should be highly specific. It is concluded that work in this area will lead to instrumentation that will be valuable for process control or environmental monitoring.

27267 **Theory of x-ray emission satellite band shapes.** Dow, J.D.; Mehreteab, E.; Swarts, C.A. (Univ. of Illinois, Urbana). *Philosophical Magazine, [Part] B: Electronic, Optical and Magnetic Properties;* **45**: No. 5, 519-527(1982). Contract AC02-76ER01198.

A change of self-consistent-field (ΔSCF) model is used to compute the effects of electron-hole interactions on the shapes of satellite X-ray bands of free-electron metals. These bands are emitted when a conduction electron annihilates one of two core holes orbiting a single atom.

27268 **Sulfur poisoning of a Ni(111) crystal with small angle boundaries (SAB) and its effect on CO adsorption.** Sargent, G.A.; Lih-Ren Chao, J.; Freeman, G.B. (Univ. of Kentucky, Lexington). *Applications of Surface Science;* **7**: 104-114(1981). Contract AS05-79ER10447.

The sulfur poisoning of a Ni(111) crystal with small angle boundaries (SAB) and its effect on CO adsorption were studied using the techniques of low energy electron diffraction (LEED) and Auger electron spectroscopy (AES). The sulfur poisoned Ni(111)-SAB surface was prepared by heating the crystal to 850°C for 20 min. The bulk sulfur impurity was diffused to the surface. The sulfur Auger peak intensities taken at and between boundary lines, show that sulfur distribution is uniform on the Ni(111)-SAB surface. No LEED pattern due to sulfur presence was observed. Sulfur atoms do not form an ordered structure in the Ni(111)-SAB surface. The Auger spectra showed that the boundary lines at the sulfur-free crystal surface provide favorable sites for the adsorbed CO to dissociate at temperatures as low as 25°C. After sulfur is diffused to the surface, it blocks the active sites as well as the boundary sites. The boundary line enhanced dissociation of CO is no longer seen. Sulfur and nickel Auger intensities were taken during the CO adsorption. From the change of the intensities, sulfur only interacts with nickel and physically inhibits the CO adsorption and, thereby, further CO dissociation.

27269 **Frame transformation relations and multipole transitions in symmetric polyatomic molecules.** Harter, W.G. (Univ. of Colorado, Boulder); Patterson, C.W.; da Paixao, F.J. *Reviews of Modern Physics;* **50**: No. 1, 37-83(Jan 1978).

The theory of transformation relations between states of Born Oppenheimer and weak coupling approximations is developed for polyatomic molecules. The relations are a generalization of frame transformation relations used by Chang and Fano for symmetric-top molecules, and they lead to a more convenient symmetry labeling system than was previously available. A key internal symmetry label (named "soul") is defined so that it remains a constant label for frame transformation relations, and is conserved during vibronic transitions, ionization, and even dissociation provided the nuclear spin-rotation interaction is relatively small. Various nomograms, graphs, and tableaus associated with the soul label make it easy to predict and visualize the form of many types of complex high-resolution spectra. Simplified procedures are given for obtaining selection rules, statistical weights, and matrix elements of multipole operators for common molecules having various point symmetries. Simplifications of computational theory using the new level cluster bases for high J are discussed.

27270 **Translational expansion of radiative interaction operators in molecules.** Chow-Chiu, L.Y. (Howard Univ., Washington, DC). *Chemical Physics Letters;* **49**: No. 2, 386-389(15 Jul 1977).

The translational expansion of radiative magnetic-dipole operators L_0 and L/sub +/-1 from the center of mass of a molecule to atomic centers is derived here in the right-handed coordinate system. It is shown that the expansion of L/sub +/-3/ at the atomic centers produces an extra gradient operator which operates on the atomic wavefunction of angular momentum l to generate wavefunctions of different angular momenta l +/- 1. This operation is illustrated by applying L/sub +/-1 (which is referred to the center of mass) to a LCAO molecular orbital π/sub u +/-/ (np), resulting in a linear combination of molecular orbital functions σ/sup u/(np), σ/sup u/(s) and σ/sub u/(d). The translational expansion of radiative electric-multipole operators is also given.

27271 **Vibrational and rotational energy transfer upon molecular collisions.** Chow Chiu, L.Y. (National Bureau of Standards, Washington, DC). *Chemical Physics (Amsterdam);* **16**: 269-279(1976).

The cross section of the rotational and vibrational energy transfer is derived by using the first Born approximation which quantizes the translational motion of the colliding particles. The theory developed here integrates the intermolecular potential V(R) over all regions of the internuclear distance R by obtaining a Fourier transform of V(R). This differs from previous semiclassical (impact-parameter) treatments which either considered the short-range repulsive interaction or expanded V(R) into a long-range multipole expansion. The cross section obtained here is expressed in a very simple algebraic expression which can be readily calculated. This will be illustrated by examples of $CO_2(001) + N_2(nu=0) = CO_2(000) + N_2(nu=1) + 18.6\ cm^{-1}$ and $CO(nu=1) + CO(nu=1) = CO(nu=0) + CO(nu=2) + 27cm^{-1}$. Calculations have been made both for the exothermic and for the endothermic reactions. The comparison of the present results with experimental results as well as with previously calculated results will be discussed.

6404 Fluid Physics

27272 **(EFI—579(66)-82) Electromagnetic wave energy characteristics in a moving medium.** Ter-Pogosyan, A.D. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701359.

Expressions for energy and energy flow in moving dispersive medium are obtained. The presence of frequency dispersion in the medium resting system is shown to result in spatial dispersion in laboratory system. The supplementary flow caused by this phenomenon is defined. Waves are divided into two groups according to the type of polarization. In a special case the propagation of both types in moving cold plasma is considered.

6450 High Energy Physics

27273 (DOE/ER/40082—T1) Summary of the Eighth Irvine conference on high energy physics. (California Univ., Irvine (USA)). 1984. Contract FG03-83ER40082. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010346.

The two day conference was attended by 260 physicists with about half from the western states and the others from the rest of the country and abroad. The funding was provided by the National Science Foundation, the US Department of Energy, and the University of California, Irvine. The nine speakers presented the most recent results and a current summary of the experimental or theoretical status of the most important areas of elementary particle physics. The selection of speakers allowed western US physicists to hear current results from the major European labs of DESY and CERN, and from the European and US labs in proton decay. Also presented were the recent results from CESR, and the status of the worldwide search for neutrino oscillations. The theoretical talks included the recent results from lattice QCD, of physics beyond the W, and an insightful talk into the basis of super gravity.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 26798, 27308, 27347

27274 (BNL—34582) Hypernuclear research at the AGS. Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 32p. (CONF-8403112—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010282.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

Although the field of hypernuclear research is over 30 years old, progress in exploring the detailed behavior of hypernuclei has been slow. This fact is due mainly to the technical problems of producing and studying these strange objects. Indeed each step in the improvement of technique has been accompanied by a breakthrough in our understanding of this fascinating subject. In this paper, the aim is to describe the evolution of hypernuclear research, stressing especially the contributions of the program based on the Brookhaven AGS. 23 references, 17 figures, 1 table.

27275 (BNL—34592) Status of the glueballs. Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 3 Aug 1983. Contract AC02-76CH00016. 43p. (CONF-8308166—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010896.

From 21. meeting of the International School of Subnuclear Physics; Erice, Italy (3 Aug 1983).

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If you assume as input axioms: (1) QCD is correct; and (2) the OZI rule is universal for weakly coupled glue in disconnected Zweig diagrams where the disconnection is due to the creation or annihilation of new flavor(s) of quark(s), then the BNL/CCNY g/sub T/(2010), g/sub T/'(2220) and g/sub T/(2360) observed in π^-p → phi phi n are produced by 1-3 primary glueballs. One or two broad primary glueballs could in principle break down the OZI suppression and mix with one or two quark states which accidentally have the same quantum numbers and nearly the same mass. However the simplest explanation of the rather unusual characteristics of our data is that we have found a triplet of J/sup PC/ = 2^{++} glueball states. Since our input axioms are in good agreement with experiments and merely represent modern QCD practice, we have very probably discovered 1-3 J/sup PC/ = 2^{++} glueballs. The iota(1440) and the θ(1700) observed in J/psi radiative decay are glueball candidates. The pros and cons of which are discussed briefly here. 41 references.

27276 (BNL—34630) Study of K^+K/sub s/π^- final state produced by π^- and anti p beams. Protopopescu, S.D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 11p. (CONF-840280—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010893.

From Recontre de Moriond meeting on electro weal interactions and unified theories; La Plaque, France (26 Feb 1984).

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We observe the production of D and E mesons in the reactions π^-p → K^+K/sub s/π^-n at 8 GeV/c and anti pp → K^+K/sub s/π^- + X at 6.5 GeV/c. A qualitative study of the Dalitz plot indicates that, unlike the D mesons, the E mesons observed in the π^-p induced reaction have different decay characteristics from those observed in the anti pp induced reaction. 7 references.

27277 (BONN-HE—83-21) Recent results from the UA5 experiment at the CERN panti p collider. Boeckmann, K. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1983. 15p. (CONF-8308131—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751267.

From 3. international conference on physics in collision; Como, Italy (31 Aug 1983).

Recent data on the multiplicity distribution of charged particles produced in non-diffractive panti p collision at $\sqrt{s}$ = 540 GeV are presented. A definite change of the normalized multiplicity distribution is observed when compared to lower energy data up to 62 GeV. A significant violation of KNO scaling is also clearly evidenced by the moments of the multiplicity distribution. The analysis of short range two particle correlations gives results for the mean cluster decay multiplicity consistent with previous results from a study of long range forward-backward correlations. The mean cluster is compatible with decaying into 1.5 resonances or directly produced stable particles which contribute in average 1.4 charged secondaries.

27278 (DESY—83-088) Contributions to the two-photon session at the 14. international symposium on multiparticle dynamics. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1983. 68p. (CONF-8306174—Exc.). NTIS (US Sales Only), PC A04 MF/A01. Order Number DE84750941.

From 14. international symposium on multiparticle dynamics; Granlibakken, CA, USA (22 Jun 1983).

This report contains four review articles concerning high Psub(t) reactions in photon-photon collisions, photon structure functions and determination of αsub(s), resonances in two-photon scattering, and Q^2 dependence of single meson production in γγ collisions. Separated abstracts were prepared for the single articles in this report.

27279 (DESY—83-102) Review of e^+e^--physics with PETRA. Lohrmann, E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 71p. (CONF-8307117—1). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751274.

From SLAC topical conference on particle physics; Menlo Park, CA, USA (27 Jul 1983).

The author reviews the most recent experiments at PETRA. These concern studies of toponium, magnetic monopoles, excited leptons, supersymmetric particles, lepton pair production as test of the standard model, branching ratios for the decays of the tau and heavy quarks, and studies of inclusive hadron production.

27280 (DESY—83-103) Electroweak interference. Boehm, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 28p. (CONF-830718—25). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751275.

From International Europhysics conference on high energy physics; Brighton, UK (20 Jul 1983).

Recent experimental results on electro-weak interference are reviewed. New data come mostly from e^{+-} experiments at PETRA and PEP. The precise measurements of leptonic reactions are used to determine the weak neutral current parameters and to test the pointlike nature of leptons. Attempts are also made to extend these studies to the reaction e^{+-} -> qanti q -> hadrons with the aim of measuring the weak neutral current couplings of heavy quarks. The review includes a brief discussion of the search for new particles and limits on alternative models to the standard electroweak theory.

27281 **(DESY—83-108) First results from the Crystal Ball at DORIS II.** Schwarz, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 25p. (CONF-830718—24). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751271.

From International Europhysics conference on high energy physics; Brighton, UK (20 Jul 1983).

The Crystal Ball has been installed at DORIS II and taking data since the fall of 1982. Data have been obtained at the Y(1S), Y(2S) and the continuum region just below the Y(2S). Preliminary results of the analyses of these data are presented. These results include inclusive photon spectra from the Y(1S) and Y(2S) and the transitions Y' -> $\pi^0\pi^0$Y and Y' -> $\gamma\gamma$Y.

27282 **(DESY—83-111) Electroweak interference, neutrino electron scattering and related topics.** Naroska, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 35p. (CONF-8308101—11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751272.

From International symposium on lepton and photon interactions at high energies; Ithaca, NY, USA (4 Sep 1983).

The main topic of this review will be the measurement of electroweak interference in e^+e^- interactions. At the end new results on neutrino electron scattering from a BNL experiment will be described and a few new results on the structure of charged weak currents will be given.

27283 **(EFI—596(83)-82) Measurement of Psub(γ) component of the polarization vector of recoil protons in π^0-meson photoproduction reaction for the angle THETAsub(πsub(0))*=60deg in resonance region.** Avakyan, R.O.; Avakyan, Eh.O.; Avetisyan, A.Eh. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701449.

Measurements of energy dependence of Psub(γ)-component of polarization vector of recoil protons in the reaction for $\gamma p \rightarrow p\pi^0$ for the pion production angle THETA*sub(πsup(0))=60 deg in the range of γ-quanta energies Esub(γ)=(0.8+1.5) GeV. The measurement results are compared with predictions of various theoretical analyses.

27284 **(EFI—602(89)-82) Experimental estimation of the contribution of secondary inelastic interactions in the multiplicity of πp mesons in pA-interactions.** Gulkanyan, G.R.; Korchagin, S.A.; Ravinovich, I.M. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701439.

Making use of the experimental data obtained with a 2 meter propane bubble chamber HEL of JINR with an internal tantalum target, the contribution of secondary inelastic processes in the multiplicity of π^--mesons in the interactions of protons with nuclei of carbon and tantalum in the momentum interval (2+10) GeV/c is estimated.

27285 **(IC—83/53) Proton decay.** Fonda, L.; Ghirardi, G.C.; Weber, T. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700903.

The problem of the proton decay is considered taking into account that in actual experiments there is an interaction of the proton with its environment which could imply an increase of its theoretical lifetime. It is seen that, by application of the time-energy uncertainty relation, no prolongation of the lifetime is obtained in this case.

27286 **(IFVE-OEIPK—83-73) Study on the Δii and Δ^0 isobar inclusive production in K^-p interactions at 32 GeV/c.** Babintsev, V.V.; Bogolyubskij, M.Yu.; Bumazhnov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701450.

The paper presents main features of the inclusive production of Δ^{++} and Δ^0-isobars in K^-p-interactions at 32 GeV/c. The estimates of the inclusive cross sections of Δ^{++} and Δ^0-production are 1.71+-0.14 mb and 1.27+-0.25, respectively. Some inclusive invariant differential cross sections of these isobars are reconstructed and the angular decay characteristics of Δ^{++} are discussed.

27287 **(ITEF—108(1982)) πi meson production under 118 deg angle in the inclusive $\pi^- A \rightarrow \pi^+ x$ reaction at 1.5 GeV/c incident momentum.** Buklej, A.E.; Burgov, N.A.; Vlasov, M.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1982. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701440.

New data on invariant cross sections of π^+ meson production in $\pi^- A \rightarrow \pi^+ X$ reactions at 1.5 GeV/c momentum of π^--meson are presented. The measurements were carried out using C, Cu, Pb and H_2O targets. The energy losses of the recorded pions in the targets were about 6 MeV for carbon and 3 MeV - for other nuclei. The efficiency of the set was calculated by the Monte Carlo method. The efficiency for carbon target depending on insident pion momentum is given in arbitrary units. An average escape angle of π^+ mesons varied from 129 deg to 100 deg. At momentum changing from 300 MeV/c to 800 MeV/c. Full width of angular distribution of recorded pions at fixed momentum was approximately 11 deg. The dependence of invariant cross sections on kinetic energy T and the escape angle THETA of the secondary pion is presented. E, p - is pion total energy and momentum. Systematic errors of section absolute normalizing constituted 10%.

27288 **(JINR—1-83-73) Cumulative proton production in pion-carbon interactions at 5 GeV/c.** Abdinov, O.B.; Bajramov, A.A.; Budagov, Yu.A.; Valkar, Sh.; Dvornik, A.M.; Lomakin, Yu.F.; Mailov, A.A.; Flyagin, V.B.; Kharzheev, Yu.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701451.

The dependence between the divergence angle and the sum of kinetic energies of two protons, one of which being emitted into the backward hemisphere, and another into the forward one in lab. c. s. in π^{-12}C interactions at p=5 GeV/c is investigated. The results obtained seem to be evidence that one of the possible mechanisms of proton cumulative production in π^{-12}C-interactions in (0.2-0.6) GeV/c momentum range is a mechanism of slow π-meson absorption by a correlated pair of nucleus nucleons.

27289 (JINR—D-2-82-568, pp 74-77) **Investigation of antideuteron-deuteron interactions on the baSe of "Lyudmila" set data.** Gremenitskij, I.M. 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

Antideuteron-deuteron interaction processes are investigated at the Ludmila device using a separated antideuteron beam and internal track-sensitive target (ITT). The evaluations performed gives the annihilation antideuteron-deuteron cross section value σsup(A)=2-4 mb, at that, the non-annihilation cross section σsup(NA)=16-18 mb. Results of deuteron and antideuteron separation are given. The ITT structUre is described. Characteristics of simultaneous sensitivity conditions in deuterium and hydrogen are given as well. Peculiarities of deuteron-antideuteron interactions are discussed.

27290 **(JINR—E-1-82-387) Search for axion on IBR-2 pulse reactor.** Alekseev, G.D.; Kalinina, N.A.; Kruglov, V.V.; Kulikov, A.V.; Kulinich, P.A.; Lushchikov, V.I.; Micelmacher, G.V.; Pokotilovsky, Yu.N.; Khazins, D.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701441.

A search for axions with plastic scintillation counters has been performed on IBR-2 pulse reactor. Behind the reactor shielding no photon pairs have been observed that contradicts the data of

Faissner on observing axions at the reactor in Julich and agrees with the conclusion of Zehnder et al. on the absence of the "standard" axion in the nature. The limitation on the axion production probability from excited states of ^{7}Li and d* is given.

27291 **(JINR—E-1-82-607) Interference of secondary pions and time-space characteristics of their emission volume in πp p interactionS at 40 GeV/c.** Akhababian, N.; Angelov, N.; Grishin, V.G.; Kowalski, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701442.

The interference of positive and negative pions produced in π^-p interactions at 40 GeV/c is studied. It is shown that negative pions are emitted from large distance than positive ones. The influence of resonance state production on the size of pion emission volume is observed.

27292 **(JINR—E-1-82-759) Study of Λsub(c)sup(+) charm baryon production in approximately 58 GeV neutron beam.** Aleev, A.N.; Arefiev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 8p. (CONF-820718—51). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701443.

From 21. international conference on high energy physics; Paris, France (26 Jul 1982).

The production of charm baryons Λsub(c)sup(+) has been observed using the spectrometer BIS-2 on a neutron beam of the Serpukhov accelerator. The charm baryons decay into anti $K^0\pi^+\pi^-$ and $\Lambda^0\pi^+\pi^+\pi^-$ with confidence levels of approximately 10 and approximately 4 standard deviations from background, respectively. The average mass M(Λsub(c)sup(+))=(2275+-6) MeV/c^2. The estimates of the product of the decay probabilities to the partial interaction cross sections are, respectively, (33.5+-5.2) μb and (4.5+-1.1) μb per carbon nucleus, and their ratio is (7.4+-2.2).

27293 **(JINR—E-1-82-802) Asymmetries in angular distributions of nucleon emission intensity in high energy hadron-nucleus collisions.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701444.

Asymmetry in nucleon emission intensity angular distributions relatively to the hadron deflection plane and to two planes normal to it and related to it uniquely is analyzed, using appropriate experimental data on pion-xenon nucleus collisions at 3.5 GeV/c momentum. Quantative characteristics of the asymmetries found are presented in tables and on figures.

27294 **(JINR—R-1-83-252) Size of an emission region of secondary pions produced in multinucleon collisions of D, He and C nuclei with C and Ta nuclei at 4.2 GeV/c per nucleon.** Agakishief, G.N.; Arnutlijski, D.; Akhababyan, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701437.

Size of the secondary pion emission region are measured by means of the second-order-interferometry method in collisions of light nuclei D, He and C with C and Ta at 4.2 GeV/c per nucleon. In the laboratory frame the root-mean-square of the radius of the pion emission region increases with the atomic weight of the projectile nucleus as well as with deepening the "centrality" of the collision. In the nucleon-nucleon c. m. s., the radius of the emission region is smaller than that in the laboratory frame.

27295 **(JINR—R-1-83-423) Average number of neutrons in πp p, π^-n and π^-^{12}C interactions at p=4 GeV/c.** Bekmirzaev, R.N.; Grishin, V.G.; Muminov, M.M.; Suvanov, I.; Trka, Z.; Trkova, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701448.

The average number of secondary neutrons has been obtained in π^-p-, π^-n- and π^-^{12}C interactions at p=4 GeV/c by means of studying secondary neutral stars induced by neutrons in propane bubble chamber. The following values of coefficients of charge exchange have been obtained: $\alpha(p \rightarrow n)$=0.39+-0.04 and $\alpha(n \rightarrow p)$=0.37+-0.08. It is shown that charge exchange coefficients don't depend on energy.

27296 (JINR-D—2-82-568, pp 47-53) **Device and main results of the NA-4 experiment: deep inelastic muons scattering and investigating multimuons states.** Argento, A.; Bollin, D.; Kamporezi, T. (Bologna Univ. (Italy). Ist. di Fisica) . 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

A NA-4 cylindrical-symmetrical focusing spectrometer operating since 1979 in a muon beam at the CERN 400 GeV accelerator is described. The device is intended for the investigation of deep inelastic muons interactions with nucleons and nuclei at 120, 200, 240 and 280 GeV to study their structure at small distances to 10^{-3} cm. Results of analysis of experimental data obtained using carbon targets are given. Conclusions obtained earlier for lower energies, that the nucleon composition includes fractional charge particles-quarks or partons, were confirmed. The parameter necessary for the quark interaction description within the framework of quantum chomodynamics was determined, the lower boundary of the product of upsilon particles by the probability of decay into two muons was established. The NA-4 carbon targets were replaced by liquid hydrogen (deuterium).

27297 (JINR-D—2-82-568, pp 67-73) **Investigation of pion-nucleon interactions at energies up to 1 GeV at the "Kaspij" device.** Golubev, S.L.; Kurepin, A.B. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

A Kaspy device located on the JINR synchrophasotron 8.1 GeV extracted proton beam and intended for using pion-nucleus interactions at energies of Up to 1 GeV is described. The device consists of a magnetooptical channel, magnetooptical spectrometer, a set of scintillation counters, a set of multiwire proportional and drift chambers a system for data pick-up from detectors, Chambers and equipment necessary for the operation and control of some separate parts of the Kaspy device. Calculated parameters of the magnetooptical channel and spectrometer of pions are given as well as measured values of pions plus yields in the magnetic channel for a brass target of 88 cm length. A program of physical investigations into elastic and inelastic pion scattering with nuclei at the Kaspy device which are necessary for the development of the microscopic theory of pion-nuclear interactions is described.

27298 **(LBL—17673) Recent results on weak decays from the Mark II experiment.** Trilling, G.H. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Apr 1984. Contract AC03-76SF00098. 15p. (CONF-8403113—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010720.

From Europhysics conference; Erice, Italy (4 Mar 1984).

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The MARK II Collaboration's work on several aspects of weak decays is described. Results on the nu/sub tau/ mass, and on tau, D^0 and B lifetimes are discussed. A brief description of the MARK II detector is given. (WHK)

27299 **(LUIP—8312) Method for analyzing elastic scattering data sampled with the SFM-detector at the CERN ISR.** Claesson, G. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). Aug 1983. 12p. (LUNFD6/NFFK—7035/1-12(1983)). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700905.

This paper describes a method for determination of the squared 4-momentum transfer, t, in elastic collisions sampled with the Split-Field-Magnet detector (SFM) at the CERN ISR. The t-values are calculated from the measured scattering angles and initial momenta of the beam particles. The method determines t with a relative error of 2 percent in Monte-Carlo generated elastic events.

The method seems to be effective in rejecting inelastic events by means of a X^2-test.

27300 **(RL—83-015) Evidence for the t-quark in p-barp collider data.** Barger, V.; Martin, A.D.; Phillips, R.J.N. (Rutherford Appleton Lab., Chilton (UK)). Feb 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700894.

A simple method is proposed to identify semileptonic weak decays $t \rightarrow e\nu b$ of any heavy particle t and to determine its mass independent of the t-production mechanism, using p-barp collider events that contain a single electron (or muon) and missing transverse momentum. Events with transverse mass Msub(T)(eν) > 3 GeV originate either from t-decays of mass msub(t) > Msub(T)(eν) + msub(b) or from $W \rightarrow e\nu$ decays; the latter is a distinctive background that can be subtracted. The Msub(T)(eν) distribution of electron events may be interpreted as being due to a t-quark with mass 25 to 40 GeV.

27301 **(RL—83-016) Finding the t-quark in W boson decay debris.** Barger, V.; Martin, A.D.; Phillips, R.J.N. (Rutherford Appleton Lab., Chilton (UK)). Feb 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700895.

A spectacular jet plus electron signature of t-quark production at p-barp colliders via W boson decay $W \rightarrow$ t-barb with subsequent $b \rightarrow$ jet, and t-bar $\rightarrow$ be-barν decays is pointed out. The b jet momentum transverse to the beam has a Jacobian peak near psub(T)(b) = (Msub(W)²-msub(t)²)/(2Msub(W)); this jet is expected to be highly collimated. Electrons from t-bar-decay occur with large momentum components normal to the b jet in the plane transverse to the beam. Both the b Jacobian peak and transverse momenta of the t-bar-decay fragments can be used in making further determinations of msub(t).

27302 **(UCRL—90687) Calculation of molecular final states and their effect on a precision neutrino mass experiment.** Fackler, O.; Mugge, M.; Sticker, H.; Winter, N.; Woerner, R. (Lawrence Livermore National Lab., CA (USA); Rockefeller Univ., New York (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1984. Contract W-7405-ENG-48. 9p. (CONF-840150—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011071.

From 4. Moriond workshop on massive neutrinos in particle and astro-physics; La Plagne, France (15 Jan 1984).

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An experiment to determine the electron neutrino mass is being performed with the precision of a few electron volts by measuring the tritium beta decay energy distribution near the endpoint. At the few electron volt level, a major consideration in the choice of a tritium source is the effect of excited final atomic or molecular states on the beta decay distribution. It is important to choose a source for which the initial and final states can be accurately calculated. Frozen tritium was chosen as the source since the states of molecular tritium and those of the HeT^+ daughter ion have electronic wavefunctions that can be calculated with high accuracy. The effects of final excited states on the neutrino mass determination and the results of these calculations are described.

27303 **Measurement of high-psub(T) correlations in 340 GeV/c pp and 280 GeV/c πp p reactions.** Oliver, W.P. (Tufts Univ., Medford, MA (USA)); Limon, P.; Mantsch, P.; Orr, J.R.; Pruss, S. (Fermi National Accelerator Lab., Batavia, IL (USA)); Cook, V.; Hicks, G.; Mockett, P.M.; Rothberg, J.E.; Williams, R.W. *Nuclear Physics* [*Section*] *B;* **228**: No. 3, 439-463(5 Dec 1983).

We have measured correlations between single high-psub(T) (1.5<psub(T)<3.5 GeV/c) trigger particles on one side of the beam line and groups of particles entering a calorimeter on the opposite side of the beam line. The mean transverse momentum measured in the calorimeter is found to increase with the trigger-particle transverse momentum. The coplanarity of the events increases with trigger-particle transverse momentum. We have compared our data with the predictions of a phenomenological four-jet model. To fit our data we find that we must give large (0.9 GeV/c) mean transverse momenta to the constituents of the initial hadrons.

27304 **Two-pion correlations in heavy ion collisions: measurement of source dimensions using pion interferometry.** Zajc, W.A.; Bistirlich, J.A.; Bossingham, R.J.; Bowman, H.R.; Clawson, C.W.; Crowe, K.M.; Frankel, K.A.; Hashimoto, O.; Kurck, J.P.; Martoff, C.J. (Lawrence Berkeley Lab., CA (USA)). *Helvetica Physica Acta;* **56**: No. 4, 978(3 Oct 1983). (CONF-8303127—).

From Swiss Physical Society spring meeting; Fribourg, Switzerland (24 Mar 1983).

Published in summary form only.

27305 **Limits on J/PSI and Y production in e^+e^- interactions at $\sqrt{s}$=29 GeV.** Matteuzzi, C.; Abrams, G.S.; Amidei, D.; Blocker, C.A.; Boyarski, A.M.; Breidenbach, M.; Burke, D.L.; Chinowsky, W.; Dieterle, W.E.; Dillon, J.B. (Stanford Linear Accelerator Center, CA (USA); California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA); Harvard Univ., Boston, MA (USA). Dept. of Physics). *Physics Letters,* [*Section*] *B;* **129**: No. 1/2, 141-144(15 Sep 1983).

A search has been made for the inclusive production of J/psi (3.1) and tau (9.4) mesons in e^+e^- interactions at 29 GeV, via their decay into two leptons. No signal is observed in the J/psi region, nor in the tau region. The limits on the cross sections are sigma(e^+e^- -> psi X) < 4.4 x 10^{-36} cm^2, and sigma(e^+e^- -> tau X) < 4.7 x 10^{-36} cm^2. The same data yield limits on the branching ratios for the b quark BR (b -> psi X) < 4.9% and BR (b -> l^+l^- X) < 0.8%.

27306 **Production and decay of charmed particles in e^+e^- collisions.** Barbaro-Galtieri, A. (Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA 94720). pp 613-688 of The new aspects of subnuclear physics. Zichichi, A. New York, NY; Plenum (1980). (CONF-7807117—).

From 16. international school of subnuclear physics; Erice, Italy (31 Jul 1978).

This is a review of all the data available on production and decay of charmed particles in e^+e^- collisions. Production and decay of D and F mesons and charmed baryons are discussed. Comparisons with theoretical predictions, where available, are made.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 27275, 27376

27307 **(DESY—83-104) Fragmentation of quarks and gluons.** Soeding, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 39p. (CONF-830718—23). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751269.

From International Europhysics conference on high energy physics; Brighton, UK (20 Jul 1983).

The author presents a review about quark and gluon jets. He describes the particle contents of the different types of jets. Finally he considers the hadronization mechanism with special regards to three-jet events in e^+e^- annihilation and hadronization in nuclear matter.

27308 **(DESY—83-105) Heavy quarks.** Khoze, V.A.; Shifman, M.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 128p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751273.

We discuss the results accumulated during the last five years in heavy quark physics and try to draw a simple general picture of the present situation. The survey is based on a unified point of view resulting from quantum chromodynamics.

27309 **(DOE/ER/10957—3) Research in the theory of condensed matter and elementary particles. Progress report.** (Chicago Univ., IL (USA)). Apr 1984. Contract AC02-81ER10957. 21p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010546.

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Progress is described on research concerned with problems occupying the common ground between quantum field theory and statistical mechanics. Research was conducted on conformal field theory and two dimensional critical phenomena; on formation of large scale structures in dynamical systems; on fermion-boson mass relations in BCS type theories; on properties of quark-gluon plasmas; on random walks in random environments; on chiral symmetry breaking in lattice gauge theories, on supersymmetric derivations of anomaly formulas and index theorems; and on the problems of exact chiral symmetry in lattice fermion theories. Publications are listed. 46 references.

27310 **(EFI—547(34)-82) Angular distributions of three-jet events in polarized e^+e^--pair annihilation.** Shakhnazanyan, Yu.G. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701416.

The dependence of the hadronic three jet production cross section in e^+e^--annihilation, taking into account the primary particle polarization, on polar THETA and azimuthal phi angles of spatial orientation as well as on the value of the thrust vector T vector is studied in the first order in "constant" dsub(s) in the framework of quantum chromodynamics. If the jet in stuching the e^+e^--annihilation at THETA=0 or phi=90 deg is detected with the maximum momentum for which T=09 then the jet consists of guarks or antiquarks in 95 events aut of 100 events and in 5 events it consists of gluons. Under the same conditions the jet with minimum momentum consists of gluons in 75% of events.

27311 **(EFI—550(37)-82) Relativistic quark model in infinite momentum frame and static properties of hadrons.** Aznauryan, I.G.; Bagdasaryan, A.S.; Ter-Isaakyan, N.L. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701417.

A model of mesons and baryons composed of reiatavistic quarks is formulated in the infinite momentum frame. A variant of this model allowing the classification over SU(6)xO(3) group is constructed. In this variant of the model the analysis of the data on the magnetic moments, electromagnetic radii for nucleon is carried out and their selfconsistent description is obtained. Estimates for mass, anomalous magnetic moments and mean square momenta of quarks in nucleons are obtained. Using these parameters the radiative decay amplitudes of P_{33} (1232), P_{11} (1470), P_{11} (1780) resonances and nucleon resonances of [70, 1^-] multiplet are predicted.

27312 **(EFI—592(79)-82) How to deal with spin in the quark model at high energies.** Aznauryan, I.G.; Grigoryan, A.A.; Ter-Isaakyan, N.L. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701418.

The close connection between the spin effects in hadron-hadron collisions and the quark wave functions in hadrons is demonstrated. In the framework of additive quark model it is shown that the correct approach to the hadron wave functions construction at S → infinity leads to the S-channel helicity flip interaction of hadrons even in the absence of such interaction on the quark level. In the considered examples our predictions agree well with the experiment.

27313 **(IC—82/181) Baryon and baryonium in QCD_2.** Durgut, M.; Pak, N.K. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1982. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84700896.

Quark-quark scattering in QCD_2 is studied by including also the contributions of the bound states other than the usual qq-bar bound states in the quark-quark scattering matrix. In particular diquark, baryon, and baryonium bound state equations are derived, and their semiclassical solutions are described. Their decays to other hadronic states are also considered.

27314 **(IC—82/229) Magnetic moments of light baryons in the harmonic model.** Khadkikar, S.B.; Gupta, S.K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700897.

Anomalous magnetic moments of light baryons are calculated in a relativistic harmonic oscillator model to obtain good agreement with experiment.

27315 **(IC—83/33) Angular distributions of dileptons in polarized hadronic collisions: Test of electroweak gauge models.** Chaichian, M.; Hayashi, M.; Yamagishi, K. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700898.

The angular distributions of high-mass dileptons with large transverse momentum produced in longitudinally polarized hadronic collisions, hadron + hadron → (γ^*, Z_1sup(c), Z_2°,...) + X → l^+l^- + X, are calculated in the QCD lowest order. The formulas presented in general form, are applicable to any gauge model of underlying electroweak interactions. Numerical results are obtained for the angular distributions in p-barp-collisions at $\sqrt{s}$=540 GeV for the Weinberg-Salam, SU(2) x U(1) x U(1)' and SU(2) x SU(2)' x U(1) models. Clearly distinguishable signals are revealed.

27316 **(IFVE-OTF—83-75) Possibility of a measurement of the gluon structure function of pion from J/psi production data.** Kartvelishvili, V.G.; Likhoded, A.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701419.

The possibility of determination of the gluon structure function of pion from J/phi production data. The x-distribution of J/phi particle in πp-interactions measured experimentally has nothing to do with gluon distributions but is related to light quark annihilation.

27317 **(IFVE-OTF—83-90) Model for elastic scattering and diffraction dissociation processes of hadrons at high energies. 2. Asymptotic behaviour of hadron form factors.** Troshin, S.M.; Tyurin, N.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701420.

The asymptotic behaviour of hadron form factors is discussed on the base of the model of elastic scattering and diffraction dissociation processes. The results are compared with experimental data. The relation between the behaviour of form factors at Q^2 → reversible and the rate of the growth of total cross-sections is derived.

27318 **(ITEF—121(1983)) Scalar partners of the mesons of the n^- Nonet.** Shabalin, E.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701421.

Properties of the chiral partners of the mesons belonging to the pseudoscalar nonet are investigated in the framework of a nonlinear chiral model of effective Lagrangian of the system of 0^+ and 0^- mesons of the known scalar resonances. Only epsilon (800) and delta (980) seem to be like the chiral partners of the mesons of o^- nonet.

27319 **(ITP—82-122-E) Complete analysis of polarization in two-particle QCD processes.** Duplij, S.A.; Rekalo, M.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Jul 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701422.

The helicity amplitudes of all two-particle quark-gluon processes qq → qq, q anti q → q anti q, qq → gg, gg → anti q anti q, gq → gq, gg → gg are obtained. Quark masses are assumed to be zero. The scattering amplitude for arbitrarily polarized particles is a linear combination of the obtained helicity amplitudes. Production

asymmetries of longitudinal polarized quarks and gluons are found. Weak and electromagnetic effects are taken into account in quark scattering.

27320 **(ITP—82-143-E) Gribov-Lipatov relation in perturbative QCD.** Pavlenko, O.P.; Snigipev, A.M.; Zinov'ev, G.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701423.

It is shown that at small X the violation of the Gribov-Lipatov relation between the distribution Dsub(A)sup(B)(X, Qsup(2)) (where X is a fraction of parton longitudinal momentum, Q^2 is a square of momentum transfer) and fragmentation anti Dsub(A)sup(B)(X, Qsup(2)) functions depends on the order in which their X- and Q^2-asymptotic behaviours are investigated.

27321 **(ITP—83-46-E) Q^2-dependence of multiparticle distribution and fragmentation functions in QCD.** Shelest, V.P.; Snigirev, A.M.; Zinovjev, C.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701424.

Using a parton interpretation of the leading logarithm diagrams of perturbation QCD theory the equations for multiparton distribution and fragmentation functions are obtained. Under certain initial conditions these equations lead to the same solutions which coincide with the jet calculus rules. The factorization of soft and hard stages of ep-scattering and e^+e^- annihilation allows to generalize the equations for the description of parton fragmentation into hadrons and parton distribution in hadrons. The effect of the initial conditions on asymptotics of the solutions to the equations obtained is considered.

27322 **(JINR—E-2-82-651) Soft and hard quark collisions in large transverse-momentum hadron-nucleus processes.** Lykasov, G.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1982. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701445.

The contribution of soft multiple constituent quark collisions to the inclusive spectrum of large transverse-momentum psub(T) particles generating in hadron-nucleus reactions at high energies is studied. By analysing the reaction $pA \to \pi X$ it is shown that this contribution is considerable and determines basically the π-meson spectra at psub(T) < or approximately 3 (GeV/c), but it decreases at psub(T) > 3 (GeV/c). The inclusion of both soft and hard quark collisions inside the nucleus allows one to describe quite satisfactorily the A dependence of these π-meson spectra within a wide region of psub(T), psub(T)=1-6 GeV/c. The quark confinement effect on the results of π-meson spectrum calculations is studied.

27323 **(JINR—E-2-82-725) Interference correlations of identical particles in models with closely spaced sources.** Lednicky, R.; Lyuboshitz, V.L.; Podgoretsky, M.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701425.

The problem of interference correlations of identical particles in the base of closely spaced sources is investigated. It is shown that the formulae for interference correlations in pairs of identical particles with nearly equal momenta, obtained in a number of papers in the framework of coherent state theory, turn out to be limiting cases of more general relations. Moreover, the latter follow from essentially simple approach based on the model of independent one-particle sources.

27324 **(JINR—E-2-82-730) Scaling of semi-inclusive spectra of πp mesons from pp interactions.** Golokhvastov, A.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701446.

Semi-inclusive distributions on π^- meson rapidity in pp interactions at 6-400 GeV/c are analyzed. It is shown that a two-parameter dependence of spectra on energy ($\sqrt{s}$) and the multiplicity of negative particles (n) reduces to a single-parameter dependence on ratio s/n.

27325 **(JINR—E-2-83-1) Representations of Poincare group associated with unstable particles.** Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701368.

The problem of relativistically-covariant description of unstable particles is reexamined. We follow the approach which associates a unitary reducible representation of Poincare group with a larger isolated system, and compare it with the one ascribing a nonunitary irreducible representation to the unstable particle alone. It is shown that the problem roots in choice of the subspace Hsub(u) of the state Hilbert space which could be related to the unstable particle. Translational invariance of Hsub(u) is proved to be incompatible with unitarity of the boosts. Further we propose a concrete choice of Hsub(u) and argue that in most cases of the actual experimental arrangements, this subspace is effectively one-dimensional. A correct slow-down for decay of a moving particle is obtained.

27326 **(JINR—R-1-82-908) Comparison of space-time characteristics of the radiation region of secondary pions produced in πpN and π^-C interactions at 40 GeV/c in different frames of reference.** Angelov, N.; Akhababyan, N.; Grishin, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1982. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701447.

Space-time characteristics of the radiation region of secondary pions produced in π^-N and π^-C interactions have been obtained using the interference method of identical particles. They are compared in different moving frames of reference. It has been found that there is no significant difference in the size of the radiation region of π^+-mesons for the two processes considered. The size of the radiation region for π^--mesons is larger than that for π^+, particularly for the component including the lifetime of the source. This can be due to an active production of resonances in these interactions.

27327 **(JINR—R-2-83-100) Nonleptonic decays of charmed baryons in chiral theory.** Kalinovskij, Yu.L.; Pervushin, V.N.; Sarikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701426.

Nonleptonic decays of charmed baryons in chiral theory are considered. The Lagrangian of weak interaction is taken in the "current x current" form and satisfies exactly the rule. $\Delta T=1$ in ideal case THETAsub(c)=0. Currents are the nonlinear realization of the chiral group SU(4)xSU(4). The nonleptonic decays of strange baryons are considered. It follows from the experimentally known data that the theory describes satisfactorily only the S-wave part of decay amplitude in the "tree" approach.

27328 **(JINR—R-2-83-169) Spectral properties of parton correlation functions and multiparton wave functions.** Radyushkin, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701385.

Using a parameteric representation for Feynman integrals it is demonstrated that the functions F(xsub(l),...,xsub(k)), phi(xsub(l),...,xsub(k)) the generalized moments of which are proportional to reduced matrix elements of k-body composite operators, have the spectral properties necessary for their parton interpretation.

27329 **(JINR—R-2-83-400) Dependence on the target-nucleus atomic number of spectra of lepton pairs produced in hadron-nucleus interactions.** Lykasov, G.I.; Sherkhonov, B.Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701438.

The dependence of lepton pair spectra (especially $\mu^+\mu^-$ produced in hadron-nuclear interactions) on the atomic number A of the target-nucleus is analyzed over their effective mass m, longitu-

dinal momentum psub(z) and transverse momentum psub(t). The investigation is carried out with such m, psub(z) and psub(t) at which the multiple rescattering of a projectile hadron or of soft multiple quark collisions give the main contribution into these spectra. It is shown that, if the spectra of $\mu^+\mu^-$ over m and psub(t) are expressed in the form of Asup(α), taking into account such processes, it permits to describe the behaviour of α(m) and α(psub(t)) rather well with spectrum index α increasing from its minimum value to α approximately 1, if m or psub(t) increases.

27330 **(JINR—R-4-83-429) Limits of application of the nolocal quark model.** Efimov, G.V.; Ivanov, M.A.; Novitsyn, E.A.; Ryabtsev, A.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701427.

The possibility of application of the nolocal quark model (NQM) to the physics of mesons, containing charmed quarks, is considered. A method for description of states with identical quantum numbers is suggested. In order to distinguish between such states different quark currents are introduced with additional condition of "orthogonality" implied. The latter allows one to neglect nondiagonal off-shell matrix elements in compositeness condition for coupling constants. In the framework of NQM with additional assumptions mentioned several decay widths of vector charmonium states have been computed, namely lepton c widths of J/psi(3100), psi'(3685) and psi(3770) an the decay width into charmed D-mesons psi(3770) → D nti D. It is shown that the two-parametric freedom of the model is not sufficient to fit the experimental data. It is concluded that the revision of basic concepts of NQM is necessary in the physics of mesons containing c-quarks.

27331 (JINR-R—1,2,13-83-81, pp 108-115) **Neutrino with Majorana masses and large oscillation amplitudes.** Bilen'kij, S.M.; Pontekorvo, B.M. 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

The problem of oscillations of neutrinos with Majorana masses is described. For some special mixing schemes in this case high amplitude neutrino oscillations can appear. A situation with oscillation amplitude is considered for two schemes with two massive Majorana neutrinos. It is shown that the "real neutrality" of neutrino with Majorana mass (unlike neutrino with Dirac mass) makes rather probable the total analogy between neutrino oscillations and K^0 reversible anti K^0, n reversible anti n oscillations with maximum oscillation amplitude.

27332 (JINR-R—1,2,13-83-81, pp 152-156) **Numerical model for the mass spectrum of six generations of leptons.** Lipmanov, Eh.M. (Yaroslavskij Gosudarstvennyj Univ. (USSR)). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

A possibility of deriving the formula for the mass spectrum of a finite number of lepton generations is discussed. The two-parametric approximated formula chisub(n)=chisub(infinity)exp(kappa/2sup(n)) is considered where chisub(n)=msub(n+1)/msub(n) (m is a lepton mass); chisub(infinity) and kappa are parameters. The index n is chosen as n=... 0, 1, 2, 3 ... for ...ν_1, e, μ, tau ... leptons. In order to limit the spectrum the following rule of sums is proposed SIGMAsub(i=1)sup(N) msub(i)– sup(neutr) - SIGMAsub(i=1)sup(N)msub(i)sup(charg.)=msub(3), where summation is performed for all neutral and charged leptons, m_3 is a mass of tau lepton, N is the unknown.number of lepton generations. It is shown that the given equations are compatible with all available experimental data and mass limits for known and supposed charged and neutral leptons only for six generations of these particles.

27333 (JINR-R—1,2,13-83-81, pp 84-92) **Results of experiments on νsub(μ)e scattering and perspectives of its investigation at the neutrino detector of IHEP-JINR.** Vovenko, A.S.; Zhigunov, V.P.; Kulikov, A.V.; Spiridonov, A.A.; Shestermanov, K.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Perspectives of investigation of elastic νsub(μ)(anti νsub(μ))esup(-) scattering at the IHEP-JINR neutrino detector are discussed. Experimental investigation of the νsub(μ)(anti νsub(μ))esup(-) scattering is extremely difficult because of smamchemical bond0cross section and high background level. According to the Salam-Weinberg model with the sinsup(2)THETAsub(w)=0.25 parameter the νsub(μ)(anti νsub(μ))esup(-) scattering and background reactions in the neutrino detector are simulated. THe calculations show that due to high accuracy of measuring electron angles and energies, possibility of separation of electron and hadron, electron and gamma quantum at the IHEP-JINR neutrino detector the νsub(μ)(anti νsub(μ))e scattering cases can be effectively isolated. The expected background level is considerably less than that attained in experiments with big electron detectors at present.

27334 (JINR-R—1,2,13-83-81, pp 97-107) **Single pion production in the νsub(μ)N→μ^-Nπ neutrino reactions.** Bel'kov, A.A.; Zudin, Yu.A.; Klimenko, L.A.; Komachenko, Yu.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Resonance and nonresonance mechanisms of the νsub(μ)N→μsup(-)Nπ reactions are considered. Within the frames of the hard pion model the νsub(μ)N→μsup(-)Nπ reactions are analysed in the Δ_{33} isobar production range. It is shown that experimental data on differential cross section for the νsub(μ)p→μsup(-)pπsup(+) reaction can be described in the hard pion model at small pulse transfers $-k^2<0.2$ $(GeV/s)^2$. Analysis of the νsub(μ)p→μsup(-)pπsup(+) reaction within the frames of the discussed model can produce valuable information about π-, p-, A_1-meson interactions with the Δ_{33} isobar. Studying of other channels of the νsub(μ)N→μsup(-)Nπ reactions in the low energy range will permit to determine the constants of π-, p-, and A_1-meson coupling with other low baryon resonances. Theoretical estimations show that the IHEP-JINR neutrino detector opens up real possibilities for experimental investigations of single pion production in neutrino scattering on virtual mesons.

27335 (JINR-R—1,2,13-83-81, pp 116-119) **Study on the oscillations of muon neutrinos at the monochromatic beam of IHEP.** Bunyatov, S.A.; Tret'yak, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)); Vovenko, A.S.; Volkov, A.A.; Mukhin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Possibility of studying muon neutrino oscillations at the IHEP-JINR neutrino detectar is discussed. Oscillations between two types of neutrino νsub(μ) and νsub(e) are considered. Limits on the difference between neutrino mass squares and $\sin^2 2\theta$ (theta is a mixing angle) attained under the given experimental conditions at the 90 % confidence level are determined. It is shown that under the same restrictions on the difference of neutrino mass squares in other experimental conditions the considerably higher sensitivity to amplitude can be obtained in the given experiment.

27336 (JINR-R—1,2,13-83-81, pp 138-143) **Possibility of search for free quarks with a fractional charge.** Bel'kov, A.A.; Volkov, A.A.; Kochetkov, V.I.; Mukhin, A.I.; Sviridov, Yu.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. (CONF-820192—).

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

One of possibilities of searching quarks with a fractional charge in a 70 GeV proton beam is studied. A quark pair production reaction in the pN → NNQ anti Q proton-nucleon interactions is considered. It is assumed that free quarks outgoing as a result of the reaction have a small cross section of inelastic interaction with nucleons. It is shown that at proton flux intensity of Isub(p) approximately (3-5)x10^{18} protons the limiting value up to $\sigma >= 10^{-43}$ cm^2/nucleon for cross section of production of quarks with the fractional charge Q=1/3 can be attained in the whole mass range available for production.

27337 **(KFTI—82-45) Relations between quadrupole moments of dibarions.** Kulish, Yu.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701428.

It is shown that account of the gluon exchange between quarks in the spherical bag leads to the difference of the quadrupole moment from zero. Electric quadrupole moments of dibaryons with the positive evenness and the amplitude of quadrupole transitions of deuteron to dibaryons are expresses in terms of the quadrupote deuteron moment.

27338 **(KFTI—83-2) Polarized vector meson production in colliding e^+e^--beams.** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701432.

Density matrix elements of vector mesons in $e^+e^- \rightarrow V+P$ and $e^+ + e \rightarrow A+P$ (V, A and P-vector, axial and pseudoscalar mesons) are revealed within the frames of one-photon mechanism. Density matrix elements are calculated in two systems: rest system V or A as well as cis of e^+e^--beams. Matrix elements of V-mesons in $e^+ + e^- \rightarrow V+P$ can be calculated accurately (without involving data on electromagnetic structure of hadrons) because $e^+e^- \rightarrow V+P$ reaction is determined only by one electromagnetic formfactor. H-odd effects for.one-photon mechanism of polarized vector meson production in $e^+ + e^- \rightarrow V+P$ reaction are also investigated.

27339 **(KFTI—83-4) Relativistic-invariant analysis of deuteron electrodisintegration. 1. Polarization effects.** Rekalo, M.P.; Gakh, G.I.; Rekalo, A.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701435.

Dependence of $e^-d \rightarrow e^-pn$ differential cross section on vector and tensor polarization of a deutron target at scattering of non-polarized and longitudinally polarized electrons (all the other particles are non-polarized) is determined in the general form using conservation of electromagnetic current of hadrons and P-invariance of hadron electromagnetic interaction. Dependence of all the asymmetries on two of five kinematic variables and, namely, on azimuthal angle phi and linear polarization parameter x of a virtual photon is clearly established within the frames of one-photon mechanism for $e^-d \rightarrow e^-pn$ (without concrete definition of $\gamma^*d \rightarrow np$ reaction mechanism, γ^* is virtual photon). Polarization of protons produced in $\gamma^*d \rightarrow np$ is analyzed in the same way. Those polarization effects which are absent in impulse approximation and which are conditioned by strong np-interaction in the final state are stated.

27340 **(KFTI—83-10) Neutral weak current and the $\nu + d \rightarrow \nu + p + n$ process.** Rekalo, M.P.; Gakh, G.I.; Rekalo, A.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701429.

For the differential cross section for deuteron-fission in neutrino scattering ($\nu+d \rightarrow \mu^- + p + p$, $\nu+d \rightarrow \nu+p+n$) with detecting of two produced particles the dependence on deuteron vector and tensor polarizations has been investigated in a general form. The structure of the matrix elements of the vector and axial parts of the hadron neutral weak current operator for the $\nu+d \rightarrow \nu+p+n$ process has been obtained considering the deuteron as an elementary particle. The spin structure of the matrix element is essentially simplified near the threshold when both vector and axial parts of the matrix elements of the $Z^*+d \rightarrow p+n$ (Z^* is the virtual Z-boson) are determined by five real threshold formfactors. Using this approach all contributions to the differential cross section for the neutrino scattering by a nonpolarized target as well as to the asymmetry the neutrino scattering by the vector and tensor polarized target have been calculated.

27341 **(KFTI—83-11) Pion electroproduction on the ^{4}He nuclei and p-odd nuclear forces.** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701436.

P-odd effects conditioned by weak electron-hadron interaction (at the expense of neutral and charged weak currents) are investigated for one-photon mechanism of $e^- + {}^4He \rightarrow e^- + \pi^0 + {}^4He$ process. P-odd effects can arise in scattering of non-polarized electrons if the produced pion is detected in the $e^- + {}^4He \rightarrow e + {}^4He + \pi^0$ reaction alongside with scattered electron. Different mechanisms of p-invariance distortion during $\gamma^* + {}^4He \rightarrow {}^4He + \pi^0$, where γ^* is virtual photon are discussed in detail. Contribution of some pole mechanisms: exchange in annihilation channel by scalar epsilon-meson (p-parity is distorted in the electromagnetic γ^*epsilonπ^0-vertex), as well as exchanges in S- and U-channels by baryon resonances with J spin and P=Jsup(P)=1/2sup(+-) parity (for $\gamma+N \rightarrow N+\pi^0$ processes the amplitudes of which within the frames of pulsed approximation determine P-odd amplitudes of $\gamma + {}^4He \rightarrow {}^4He + \pi^0$) is determined in the near-threshold region. These mechanisms result in P-odd pion production in the S-state, that increase P-odd effects near the threshold.

27342 **(KFTI—83-12) Polarization effects in vector meson electromagnetic decay (rho $\rightarrow \pi + 1^+ + 1^-$, $A_1 \rightarrow \pi + 1^+ + 1^-$).** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701430.

Angular and energy distributions of decay products .of polarized vector and axial mesons with production of $V \rightarrow P + l^+ + l^-$ and $A \rightarrow P + l^+ + l^-$ lepton pair, where V, A and P are vector, axial and pseudoscalar mesons, l is a lepton, are investigated in the general form. Study of polarized phenomena in $A \rightarrow P + l^+ + l^-$ decay permits to determine both complex electromagnetic formfactors of the vertex APγ^* in the region of time-like momentum transferred. It is disclosed that $A_1 \rightarrow \pi + l^+ + l^-$ decays may turn to be most useful for study of p-odd effects in the processes of A_1-meson production. Analysis of p-odd effects in $V \rightarrow P + l^+ + l^-$ decays for one-photon mechanism (at the expense of distortion of P-invariance in the electromagnetic vertex VPγ^* ($\gamma.^*$ is virtual γ-quantum) is conducted.

27343 **(KFTI—83-14) Manifestation of weak interaction in the ep $\rightarrow e\mu^+\mu^-x$ reaction.** Barannik, V.P.; Stoletnij, I.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701431.

$ep \rightarrow e\gamma^*x \rightarrow e\mu^+\mu^-x$ (in the region of small invariant masses of $\mu^+\mu^-$-pair) and $ep \rightarrow ezx \rightarrow e\mu^+\mu^-x$ (z-boson on mass surface) reactions are studied within the frames of quark-parton model. x is nondetected sum of particles. It is revealed that squares of matrix elements of $eq \rightarrow e\gamma^*q$ and $eq \rightarrow eqz$ (q-quark) processes are expressed by means of the same six functions of standard invariant variables. Different differential cross sections of the considered processes are calculated. It is shown that differential cross section of $ep \rightarrow ezx$ process complying with detection of an electron with energy E_2 and angle of escape thetasub(l) as well as square of invariant mass of finite electron and z-boson S_1 considered as S_1 function has a sharp peak the value and position of which depend on E_2 and thetasub(l).

27344 (KFTI—83-23) Charm particle jet production at the neutrino-valent gluon interaction. Merenkov, N.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701433.

The process of C anti C and C anti S pair production caused by neutrino-valent gluon interaction is considered in the experiment when in the final state alongside with the pair produced C anti C(C anti S) also scattered neutrino (μ-meson) is registered. Near the threshold and in the high-energy range all the contributions to differential cross section, characterizing polarization states of intermediate Z- and W-bosons, are calculated. The limiting cases of small and big squares of momenta transfered are discussed. At high energies the contribution of P-odd interference of vector and axial currents to differential cross section, which is determined by antisymmetric longitudinal-trasverse part of hadron tensor in the range qsub(perpendicular)sup(2) vector $<< m^2$ and $-K^2 >> m^2$, behave as $\sqrt{}$ -ksup(2)/qsub(perpendicular)sup(2) as to transverse cross section. Non-conservation of vector current in the case of C anti S pair production results in the appearance of summands proportional to (msub(c)sup(2)-msub(s)sup(2))/Ksup(2) in longitudinal and longitudinal-transverse (connected with symmetric part of hadron tensor) cross sections.

27345 (LA-UR—84-1009) Stochastic methods for the description of multiparticle production. Carruthers, P. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-840275—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009981.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

Dynamical questions in the evolution of excited hadronic matter are reviewed, with emphasis on KNO scaling and its possible violation. It is suggested that the KNO distributions is described by a stochastic evolution of the Fokker-Planck type related to underlying field theory by coupled rate equations approximated by Langevin equations with noise. Refined correlation analysis of data, especially the use of intensity interferometry techniques, is recommended for data analysis. 26 references.

27346 (RL—83-011) Perpendicular eν mass from W decay. Barger, V.; Martin, A.G.; Phillips, R.J.N. (Rutherford Appleton Lab., Chilton (UK)). Jan 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700892.

Properties of the perpendicular eν mass, defined in terms of transverse momenta p-vectorsub(T) by Msub(T)sup(2)(eν) = 2'p-vectorsub(eT)' 'p-vectorsub(νT)' - 2p-vectorsub(eT).p-vectorsub(νT), that make it particularly well suited to W mass and width determinations are examined. An analytic expression for its distribution in W production and subsequent W $\rightarrow$ eν decay at p-barp colliders, accurate to order <psub(WT)sup(2)/Msub(W)sup(2)> approximately equal to 1% is given. A maximum likelihood fit of this formula to the five UA1 events gives Msub(W) = 80.3 +- $_3{}^6$ GeV.

27347 (SLAC-PUB—3300) Heavy particle production at the SSC. Brodsky, S.J.; Haber, H.E.; Gunion, J.F. (Stanford Linear Accelerator Center, CA (USA); California Univ., Santa Cruz (USA). Dept. of Physics; California Univ., Davis (USA). Dept. of Physics). Mar 1984. Contract AC03-76SF00515. 6p. (CONF-840275—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010575.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

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Predictions for the production of heavy quarks, supersymmetric particles, and other colored systems at high energy due to intrinsic twist-six components in the proton wavefunction are given. We also suggest the possibility of using asymmetric collision energies (e.g., via intersecting rings at the SSC) in order to facilitate the study of forward and diffractive particle production processes. 9 references.

27348 (TRI-PP—83-129) Pion absorpton and production in few nucleon systems. Jones, G. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Dec 1983. 23p. (CONF-830862—16). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84900955.

From 10. international conference on few-body problems in physics; Karlsruhe, F.R. Germany (21 Aug 1983).

Investigations of pion production and absorption in few nucleon systems is clearly the means for studying both the elementary pion creation and annihilation processes and the associated problem of the propagation of pions and excited nucleons within nuclear matter. In this paper I wish to discuss those aspects of the subject which have received most attention by the contributors to this conference. Since David Bugg has discussed the NN $\rightarrow$ NN π situation in some detail, I shall restrict my treatment of the NN system to involve only the specific reaction $\pi d \rightleftharpoons 2p$. In addition, I will discuss a few selected topics concerning pion production and absorption in few nucleon systems, primarily to point out areas in which significant activity is currently in progress. I shall also restrict all discussion to those situations in which only one pion is involved, excluding any mention of multi-pion processes. 64 references.

27349 Y decay into two gluinos. Eilam, G.; Khare, A. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Physics Letters, [Section] B;* **134**: No. 3/4, 269-270(12 Jan 1984).

Mass splitting between the superpartners of the b quark may induce a substantial branching ratio for Y -> gg if msub(g) < 5 GeV.

27350 Model-independent analysis of quark and gluon fragmentation. Hoyer, P. (Stanford Linear Accelerator Center, CA (USA); Stanford Univ., CA (USA)). *Physics Letters, [Section] B;* **133**: No. 1/2, 108-110(8 Dec 1983).

Multiple jets produced in hard collisions fragment independently. Correlations between their fragments arise through dependence on the jet type (quark flavour, gluon). We propose a simple method for exploring the differences in quark and gluon fragmentation using data on correlations in e^+e^- and large psub(T) hadron collisions.

27351 Evidence for charmed-strange exotic mesons. Suzuki, M. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)); Tuan, S.F. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). *Physics Letters, [Section] B;* **133**: No. 1/2, 125-128(8 Dec 1983).

We suggest that the 1970 MeV state recently discovered in e^+e^- annihilation at CESR is the F^+ meson and the old 2020 MeV state is the (canti sqanti q)sub(I=0) state (q=u,d) of Jsup(P)=0^+. SU(3) analysis indicates a rich spectrum of charmed four-quark states. Semi-quantitive arguments are presented for the reason why the 2020 MeV state decays dominantly through weak interactions.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 27375

27352 (EFI—608(95)-82) Renormalization of N=4 supergauge theory. Grigoryan, G.V.; Grigoryan, R.P.; Tyutin, I.V. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701363.

The conservation of N=4 supersymmetry after the renormalization of N=4 supersymmetric Yang-Mills theory is proved.

27353 (KFTI—83-3) P-odd effects in the πip+q $\rightarrow$ $\mu^+ + \mu^- + q'$, q+ anti q' $\rightarrow \pi^{+-} + \mu^+ + \mu^-$ processes and P-odd constant of π^{+-}qq'-interaction. Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701434.

P-odd effects for one-photon mechanism of muon pair production in hadron collisions conditioned by contribution of π^{+-}+q

$\rightarrow q'+\mu^+ +\mu^-$ and q+ anti $q' \rightarrow \pi^{+-}+\mu^+ +\mu^-$ pion mechanisms are studied. The $\pi^{+-}+q \rightarrow qq+\gamma^*$ (γ^* is virtual γ-quantum) process is considered in Born approximation within the frames of which P-odd effects arise due to P-odd constant of $\pi^{+-}qq'$-interaction. It is shown that in collision of non-polarized particles P-odd effects in $a_1+a_2 \rightarrow \mu^+ +\mu^- +X$ (a_1 and a_2 - colliding hadrons, X-nondetected set of particles) are conditioned by imaginary part of pion electromagnetic formfactor in the region of time-like momentum transferred for the considered mechanism if non-polarized muons are produced. Detection of P-odd effects in $a_1+a_2 \rightarrow \mu^+ +\mu^- +X$ due to P-invariance breaking in πq-collisions is essential for determination of P-odd constant of $\pi^{+-}qq'$-interaction.

27354 **(RL—83-012) Geometric hierarchy for the supersymmetry breaking scale.** Oakley, C.; Ross, G.G. (Rutherford Appleton Lab., Chilton (UK)). Jan 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700893.

F type supersymmetry breaking through O'Raifeartaigh-Fayet (Nucl. Phys.; B96:331 (1975) and Phys. Lett.; 580:67 (1975)) potentials is considered. It is shown how a class of models gives rise to a supersymmetry breaking scale reduced relative to the fundamental scale M of the potential by powers of (M/Msub(Planck)). The role of R invariance in such potentials is discussed.

6454 Field Theory

REFER ALSO TO CITATION(S) 27309, 27354

27355 **(EFI—584(71)-82) Loops and strings in QCD.** Migdal, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701360.

Concepts and methods of the dynamics of loops and strings in QCD are discussed and illustrated after the example of the model of random matrices interacting with quark fields. The first terms of 1/N expansion are constructed for this model.

27356 **(EFI—585(72)-82) Loop kinematics.** Migdal, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701361.

Basic operators acting in the loop space are introduced. The topology of this space and properties of the Stokes type loop functionals are discussed. The parametrically invariant loop calculus developed here is used in the loop dynamics.

27357 **(EFI—586(73)-82) Loop equations.** Migdal, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701362.

The grounds, physical meaning and mathematical features of loop equations are discussed in detail for the Wilson averages in abelian and nonabelian gauge theories. A connection is established with planar diagrams. The law of areas is shown to serve as a self-consistent solution for large contours.

27358 **(IFVE-OTF—82-95) Modifications of forms of relativistic dynamics related to the Poincare transformations.** Sokolov, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1982. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701364.

On the basis of an algebraic definition of a modification of the form of relativistic dynamics a general form of modifying transformations is found and all the modifications of the point, instant, and front forms of dynamics and their limiting cases are described. It is shown that the limit of modifications of the instant form of dynamics (if it exists and is nontrivial) is in a general case the quasi-front form of dynamics with a 6-dimensional free subalgebra and, in cases of the absence of bound states and of the Bakamjian-Thomas model, it is the front form of dynamics.

27359 **(ITEF—52(1983)) Vector fields and projective transformations.** Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701365.

Vector fields, invariant under monoparametric fraction-linear group of transformations of n-dimensional space, have been studied. Realization conditions of the vector fields in n-dimensional projective space are presented.

27360 **(ITEF—69(1983)) Vector fields and invariant symmetry groups.** Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701366.

Realization conditions of smooth tangent of vector fields, invariant under symmetry groups, on certain manifolds are presented. Also realization conditions of vector fields, invariant under regular homogeneous and heterogeneous covers of plane, sphere and crystallographical groups on the plane, are studied.

27361 **(JINR—E-2-83-28) Conformal invariance in gauge theories. Quantum electrodynamics.** Zaikov, R.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701374.

In the present paper another nontrivial model of the conformal quantum electrodynamics is proposed. The main hypothesis is that the electromagnetic potential together with an additional zero scale, dimensional scalar field is transformed by a nonbasic and, consequently, nondecomposable representation of the conformal group. There are found nontrivial conformal covariant two-point functions and an invariant action from which equations of motion are derived. There is considered the covariant procedure of quantization and it is shown that the norm of one-particle physical states is positive definite.

27362 **(JINR—E-2-83-44) Conformal invariance in the gauge theories. Yang-Mills theory.** Zaikov, R.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701379.

In the present paper the results of the first part are generalized to the nonabelian case. From the assumption that the Yang-Mills fields together with the one scalar zero-dimensional fields are transformed by the nonbasic representation of the conformal group, it follows that the covariant propagator has a nonzero transversal part. These fields are transformed also by an adjoint representation of a local gauge group SU(N). For the construction of an invariant action it is necessary to introduce a second zero-dimensional scalar field which is SU(N) invariant. There are derived the corresponding equations of motion as well as subsidiary conditions which are compatible with the equations of motion.

27363 **(JINR—E-2-83-49) Supersymmetric quasipotential equations. Supersymmetric generalization of the Todorov-type equations.** Zaikov, R.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701380.

A supersymmetric extension of the Todorov-type quasipotential equations is considered. Applying to the two-particle Bethe-Salpeter amplitude the supersymmetric Markov-Yukawa condition, the corresponding constraints are found which give the transition to the one-time wave function. The corresponding supersymmetric three-dimensional equations are written down. The Born terms of the quasipotential in the case of a self-interacting chiral superfield as well as of interaction with one massless chiral superfield are given.

27364 **(JINR—E-2-83-104) U(1)-supersymmetric extension of the Liouville equation.** Ivanov, E.A.; Krivonos, S.O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701369.

The N=2 supersymmetric extension of the Liouville equation is presented. The zero-curvature representation is constructed (on superalgba osp(2/2)) together with an associated linear set, its general solution is found and the reduction to the N=1 case is discussed. An intrinsic connection of the N=0, N=1, and N=2 Liouville equations with the infinite dimensional contact (super) algebras K(1), K(1/1) and K(1/2) from Kac list is established.

27365 **(JINR—E-2-83-150) Representations of osp(1.4) in terms of three boson pairs and matrices of arbitrary even order. The basic theorem.** Bedner, M.; Blank, J.; Havlicek, M.; Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701370.

The study of the class of infinite-dimensional Schur-irreducible star representations of the Lie superalgebra osp(1,4), introduced in the first part of the paper, is continued. The matrix relations determining the structure of the class are analyzed in detail and all non-equivalent solutions of these relations are given explicitely.

27366 **(JINR—E-2-83-213) Mass renormalization in supersymmetric Yang-Mills theories.** Sazdovic, B.T.; Tarasov, O.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701371.

The mass renormalization in supersymmetric Yang-Mills theories are studied. It is found that at least in first orders of perturbation theory the mass and charge renormalization constants coincide.

27367 **(JINR—E-2-83-253) Stability properties of solutions to nonlinear models possessing a sign-undefined metric.** Barashenkov, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701372.

Multicomponent field systems possessing a sign-undefined internal space metric, in particular models with a noncompact global invariance group are investigated. It is shown that the energy cannot have even a conditional relative minimum. It is demonstrated, nevertheless, that the corresponding nonlinear equations of motion are permitted to possess stable particle-like solutions.

27368 **(JINR—E-2-83-264) Space-time structure of radiative corrections.** Vyshensky, S.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701373.

Method of obtaining equations for the total Green functions of quantum electrodynamics, exact and approximate solutions of which are free of nonphysical singularities and approximate ones are analytic in the coupling constant at zero, is developed on the base of the Schwinger source theory. The corresponding space picture of virtual- and real-process contributions to the total Green function is given. A comparison with quantum field theory equations is presented.

27369 **(JINR—E-2-83-283) Quantum effects in the Schwinger model.** Ilieva, N.P.; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701375.

The aim of the paper is to investigate some purely quantum effects of motions of the fermion and boson vacua in the massless Schwinger model. The Dirac vacuum collective motions are investigated. The gauge field vacuum is topologically degenerated. It is emphasized that the massless Schwinger model gives an example of dependence of the physical results in quantum theory on the choice of the vacuum and on the global properties of the gauge field configuration space.

27370 **(JINR—E-2-83-286) Nonlinear realization of the conformal group in two dimensions and the Liouville equation.** Ivanov, E.A.; Krivonos, S.O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701376.

The Liouville equation usub(+-)=msup(2)esup(-2u) is shown to have an adequate descpiption in terms of the nonlinear realization of infinite parameter conformal group G in (1+1) dimensions. The (1+1) - Minkowski space coordinates x^+, X^- and the field u(x) are identified with certain parameters of the coset G/H, H=S0(1, 1) being the (1+1)-Lorentz group. The Liouville equation appears as one of the covariant constraints reducing this coset space to its connected geodesic subspace SL(2, R)/H. An alternative reduction to the subspace P(1, 1)/H (P(1, 1) is (1+1)-Poincare group), yields the free equation for u(x). It is demonstrated that the relevant zero-curvature representations and Becklund transformations get a simple group-theoretic interpretation within this approach and discuss a possibility of its extension to other integrable systems.

27371 **(JINR—E-2-83-323) Calculation of Feynman integrals by the method of "uniqueness".** Kazakov, D.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701377.

The applications of the method to calculate massless Feynman integrals based on the "uniqueness" relation are developed and discussed. The procedure consists of several algebraic steps and involves neither integration of elementary, special or any other functions, nor expansions in and summation of infinite series of any kind. The simplicity and efficiency of the method are illustrated by the calculation of two- and three-loop dimensionally regularized integrals. As an application of the proposed technique given is the analytical calculation of the remaining diagrams completing the five-loop renormalization group calculations in the phi^4 model.

27372 **(JINR—R-2-82-647) Embedding equations for the relativistic string world sheet in the many-dimensional spaces.** Barbashov, B.M.; Koshkarov, A.L.; Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1982. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701383.

The Gauss-Godazzi-Ricci equations which describe the world sheet of the relativistic string (two-dimensional minimal surface) in the six-dimensional pseudo-Euclidean space with the Minkowski signature of the metric, are reduced to the system of five nonlinear partial differential equations for five scalar functions of two independent variables. In this system there are three second order equations and two first order ones. The general solution of these equations can be constructed in an explicit form.

27373 **(JINR—R-2-83-266) Calculation of the Casimir effect for scalar fields with the simplest nonstationary boundary conditions.** Bordag, M.; Petrov, G.; Robashik, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701386.

The starting point for the calculation of the Casimir force is the vacuum energy as a function of the distance a between the two plates. The question arises: Does the motion of one of the plates with constant velocity change the structure of the vacuum state and therefore the Casimir force essentially. It is shown that the Casimir force takes the form Fsub(K)=$C_0/a^4(1+8/3xv^2/c^2+...)$ that generalized the already known expression for v=0.

27374 **(JINR—R-17-83-171) Anisotropic solitons in a space of dimension n > 1 in theories with the abelian global gauge group.** Grishin, V.E.; Fedyonin, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701382.

Solutions are found in the form of "isomeric n-solitons" defined on equipotential hyperplanes, σ=ksub(μ)xsub(μ), of an n-dimensional space (at x_0=const), i. e. in the planes σsub(i), where the

function rhosub(i) is a constant, rho(σsub(i))=Csub(i). This class of solitons is an analog of n-dimensional anisotropic solitons. A physical interpretation of such solutions is possible for n=1, 2, 3. This model admits also solutions in terms of elliptic functions for which it is enough to know exactly the roots of the polynomial Psub(2N)E-U(rho).

27375 **(TRI-PP—83-126) Supersymmetry and supergravity: a short review.** Campbell, B.A.; Fogleman, G. (Carleton Univ., Ottawa, Ontario (Canada). Dept. of Physics; British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Dec 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84900954.

Portions are illegible in microfiche products.

The purpose of this review is to give an introduction to the basic ideas of supersymmetry and supergravity. The first part of this review, on supersymmetry, treats the super-Poincare group and discusses the Wess-Zumino model and supersymmetric gauge theories in both superfield and component field language. The second part describes theories of supergravity and discusses the construction of locally supersymmetric Lagrangians. An attempt is made to give both the abstract point of view and a nuts and bolts description of these thories. 15 references.

27376 **Rho-$\pi\pi$ coupling constant in lattice gauge theory.** Gottlieb, S. (California Univ., San Diego, La Jolla (USA)); Mackenzie, P.B.; Thacker, H.B. (Fermi National Accelerator Lab., Batavia, IL (USA)); Weingarten, D. (Brown Univ., Providence, RI (USA)). *Physics Letters,* [*Section*] *B;* **134**: No. 5, 346-350(19 Jan 1984).

We present a method for studying hadronic transitions in lattice gauge theory which requires computer time comparable to that required by recent hadron spectrum calculations. This method is applied to a calculation of the decay rho -> $\pi\pi$.

27377 **Supersymmetry and non-compact groups in supergravity.** Ellis, J. (Stanford Linear Accelerator Center, CA (USA)); Gaillard, M.K.; Zumino, B. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)); Guenaydin, M. (Ecole Normale Superieure, 75 - Paris (France). Lab. de Physique Theorique). *Nuclear Physics* [*Section*] *B;* **224**: No. 3, 427-450(19 Sep 1983).

With 50 refs.

We study the interplay of supersymmetry and certain non-compact invariance groups in extended supergravity theories (ESGTs). We use the N=4 ESGT to demonstrate that these symmetries do not commute and exhibit the infinite-dimensional super-invariance algebra generated by them in the global limit. Using this result, we look for unitary representations of the full algebra. We discuss the implications of our results in the context of attempts to derive a relativistic effective gauge theory of elementary particles interpreted as bound states of the N=8 ESGT.

6455 Scattering Theory

27378 **(JINR—R-17-83-88) Some specific features of scattering on solitons in the model of current-current interaction. Phases and cross section of scattering in kinematic region of t=(q²) contains (0.4 m²).** Grishin, V.E.; Fedyanin, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701393.

On the basis of calculated form factor of a soliton with pole specific properties in the kinematic region of t=q² contains (0.4 m²) momenta scattering phases at the transition through poles and the behaviour of the scattering cross section in these points are analysed. The connection between poles and resonances in total cross section is shown. The resonance number on q² contains (0.4 m²) range is final and is determined with a simple ratio. Each separate peak, taking into account background shift, is a resonance of Breit-Wigner type.

65 PHYSICS. II.

6510 Nuclear Physics

27379 **(EUR—8529) 1982 annual status report. Nuclear measurements.** (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701452.

The Nuclear Measurement programme is briefly presented in this status report, it is divided in two main projects, Nuclear Data on the one hand (neutron data, non neutron nuclear data) and Nuclear Reference Materials and Techniques on the other (nuclear reference materials, samples and targets for nuclear measurements, development of reference techniques, study for the production of enriched actinide isotopes).

27380 (JINR-D—2-82-568, pp 26-46) **Program of experimental study at JINR synchrophasotron in the range of relativistic nuclear physics.** Kuznetsov, A.A. 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

The modern state of the experimental investigation program at the JINR synchrophasotron in the area of relativistic nuclear physics is reviewed. Possibilities of the further program development are shown. Results of an experimental tests of consequences of the cumulative effect hypothesis and structural quark-parton nucleus function are discussed as well as results of search for and study of exotic particles, which are not described with usual quark schemes. Results of studying the multiple particle production process during the interactions of relativistic nuclei and nuclei produced lately at the synchrophasotron by HEL physicists are reviewed as well. It is concluded that at present relativistic nuclear physics is successfully developed at JINR as a new scientific area. During short time period JINR physicists obtained scientific results which are recognized all over the world. Present synchrophasotron possibilities and its further evolution as a relativistic and polarized nucleus accelerator will permit the JINR scientists not only to successfully accomplish the actual and competitive investigation program in the area of relativistivc nuclear physics but also to obtain in future new results considerably affecting the evolution of the fundamental investigation theory.

27381 (JINR-D—2-82-568, pp 108-113) **Principal results of nucleus-nucleus collisions and DISK-3 installation.** Stavinskij, V.S. 1982. (In Russian). NTIS (US Sales Only), PC A09/MF A01. (CONF-8205252—).

From Meeting on investigations in the field of relativistic nuclear physics; Dubna, USSR (25 May 1982).

Main results of investigations into nucleus-nucleus collisions obtained by techniques of scintillation and Cherenkov detectors, spark chambers, nuclear photoemulsions are discussed. Processes with small momentum transfers (< 300 MeV/c) obtained in JINR and ITEPh were considered as well as interactions with large momentum transfer (over 100 GeV/c) during the CERN-JINR experiment (cumulative processes). A derive flowsheet, which is constructed for studying correlations in the cumulative particle production, is given. The device operates on line With the ES-1040 electronic computer. The primary proton intensity is approximately 5 x 10^{11}. A minimum level of inclusive cross sections for a nucleon of a fragmenting nucleus, which can be studied at the device, constitutes approximately 10^{-36} cm² per unit of phase volume. A physical investigation program is presented.

27382 **(LA-UR—84-788) Fission product and actinide data status in ENDF/B.** England, T.R.; Young, P.G.; Schenter, R.E.; Mann, F.M.; Reich, C.W. (Los Alamos National Lab., NM (USA); Hanford Engineering Development Lab., Richland, WA (USA); Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract W-7405-ENG-36. 23p. (CONF-840389—4). NTIS, PC A02; 3; GPO Dep. Order Number DE84010060.

From US-Japan information exchange seminar on photochemical energy solar conversion; Okazaki, Japan (12 Mar 1984).

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The US Evaluated Nuclear Data Files (ENDF/B) have been very successful in this country and internationally. The data are used directly in calculations or as a reference for comparison with new measurements and other international data bases. The data formats, being particularly suited for computer processing codes, have been recommended by the IAEA as the preferred method of exchange for international data. Part of this success is due to a remarkably free exchange of data nationally and internationally. Additionally, of course, it is due to the many needs for such a comprehensive, evaluated data base. The current version, ENDF/B-V was released in 1979 and 1980. Both ENDF/B-IV and -V were greatly expanded in the areas of fission products and actinides, and the cross section evaluations have been improved in each new version. ENDF/B-VI was originally scheduled for completion in late 1986. However, this schedule is now questionable, as is, the extent of its content. Comments are directed at the improvements we feel are needed for ENDF/B-VI, irrespective of the time scale or probability of implementation. Additionally, we limit our considerations to fission products and heavy nuclides (which we loosely call actinides) and specifically to plans at Los Alamos National Laboratory (LANL), Hanford Engineering and Development Laboratory (HEDL), and Idaho National Engineering Laboratory (INEL). In cur coverage we emphasize cross sections and yields for fission products and decay data for both fission products and actinides. We do not attempt complete coverage of planned evaluations of actinide cross sections nor other ENDF/B general and special purpose files (e.g., General Purpose, Activation, Standards, etc.), although some of the data we cite lies in those files. However, our summary of data content in the current ENDF/B-V files is complete for fission products and actinides.

27383 (NEANDC(E)—232-U(Vol.5)) Progress report on nuclear data research in the Federal Republic of Germany for the Period April 1, 1981 to March 31, 1982. (Nuclear Energy Agency, 75 - Paris (France). Nuclear Data Committee). 1982. 103p. (INDC(GER)—24-L(Special)). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84700906.

This report has been prepared to promote exchange of nuclear data research information between the Federal Republic of Germany and the other member states of NEA and IAEA. The emphasis has been on measurement, evaluation and compilation of application-oriented nuclear data, such as those relevant to fission and fusion reactor technologies, development of intense spallation neutron sources, production of medically important short-lived radioisotopes, etc. Each contribution is presented under the laboratory heading where the work was done.

27384 (SLAC-PUB—3320) A-dependence of deep-inelastic electron scattering from nuclei. Arnold, R.G.; Bodek, A.; Bosted, P.E.; Chang, C.C.; Giokaris, N.; Gomez, J.; Katramatou, A.T.; Lombard, R.M.; Mecking, B.A.; Petratos, G.G. (Stanford Linear Accelerator Center, CA (USA); American Univ., Washington, DC). Apr 1984. Contract AC03-76SF00515. 6p. (CONF-840280—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84010677.

From Recontre de Moriond meeting on electro weal interactions and unified theories; La Plaque, France (26 Feb 1984).

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The deep inelastic electron scattering cross sections per nucleon σ/sub A/ for d, He, Be, C, Al, Ca, Fe, Ag, and Au were measured in the kinematic range $0.09 \leqq x \leqq 0.9$ and $2 \leqq Q^2 \leqq 15$ $(GEV/c)^2$ using electrons with energies ranging from 8 to 24.5 GeV. The ratio σ/sub A//σ/sub d/ is consistent with unity in the range $0.1 < x < 0.3$. For $0.3 < x < 0.8$, the ratio decreases logarithmically with atomic weight A, or linearly with average nuclear density. No Q^2 dependence in the ratio was observed over the kinematic range of the data. 12 references.

27385 Cross section and vector analyzing power iT_{11} of the processes ^{3}He(d vector,d)^{3}He(d vector,p)^{4}He between 15 and 40 MeV. Roy, R. (Lawrence Berkeley Lab., CA); Seiler, F.; Conzett, H.E.; Rad, F.N. *Physical Review* [*Section*] *C: Nuclear Physics;* **24**: No. 6, 2421-2434(Dec 1981).

Differential cross sections σ_0(theta) and angular distributions of the vector analyzing power iT_{11}(theta) have been measured for the processes ^{3}He(d vector,d)^{3}He(d vector,p)^{4}He from 15 to 40 MeV in intervals of 5 MeV. Data were obtained typically at 25 to 35 angles. In both reactions the angular distributions of the observables, expanded in terms of Legendre polynomials, clearly show structure near 20 and 35 MeV. In addition, an optical model fit to the elastic scattering data was used in an attempt at a distorted-wave Born approximation analysis of the reaction data.

27386 (IC—82/163) Additional evidence for the existence of the ^{12}C nucleus as three α-particles and not as ^{8}Besub(g.s.)+α. Abou Steit, S.A.H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700900.

The probability 'A'^{2} for the existence of the ^{12}C nucleus as a ^{8}Be nucleus in its ground state plus an α-particle has been calculated in PWBA by comparing the differential cross-sections of the stripping reactions (^{12}C,^{8}Be) and (^{8}Be,α) for transitions between the same energy levels. The reactions ^{12}C(^{12}C,^{8}Be)^{16}O and ^{16}O(α,^{8}Be)^{12}C, available in the literature and leading to the ground states of the final nuclei, have been considered normally for the first one and by reciprocity in the reverse direction for the second one in order to have identical targets and residual nuclei in both cases. The results have shown, as expected, that this probability 'A'^{2} is very small which rejects the picture of the ^{12}C nucleus as a ^{8}Besub(g.s.) nucleus plus an α-particle and supports the 3α-particles structure for the ^{12}C nucleus.

27387 (IC—83/15) Electron scattering from ^{13}C. Il-Tong Cheon. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700902.

Transverse form factors for elastic and inelastic electron scattering from ^{13}C have been calculated with the Cohen-Kurath wave functions, by introducing an alteration into the nucleon form factor in nuclei. The results show good agreement with the data. We have concluded that the Cohen-Kurath wave function can reproduce the experimental results of photopion production and electron scattering from ^{13}C in the momentum transfer, q<or approx. 2 fm^{-1}.

27388 Resolution of a coulomb reorientation ambiguity in ^{18}O. Gross, E.E.; Fewell, M.P. (Oak Ridge National Lab., TN (USA)). *Nuclear Physics* [*Section*] *A;* **411**: No. 2, 329-336(19 Dec 1983).

Elastic scattering data and inelastic excitation of the lowest 2^+ state in ^{18}O from 120 MeV ^{18}O incident on ^{208}Pb are analyzed in coupled channels including couplings to the second 2^+ state of ^{18}O. This analysis favors the positive sign for the product of the four E2 matrix elements, $p_4 = M_{0121}M_{0122}M_{3122}M_{3121}$, where Msub(ij)=-<iparallelM(E2)parallelj>. This is in agreement with shell-model calculations.

27389 Polarized triton capture on ^{12}C. Drake, D.M.; Wender, S.A.; Roberson, N.R. (Los Alamos National Lab., NM (USA)); Weller, H.R. (Duke Univ., Durham, NC (USA). Dept. of Physics; Triangle Universities Nuclear Lab., Durham, NC (USA)). *Nuclear Physics* [*Section*] *A;* **410**: No. 3, 429-440(5 Dec 1983).

The 90° cross section for the ^{12}C(t,γ_0)^{15}N reaction was measured for E_t from 2.3 to 6.5 MeV. Polarized and unpolarized angular distribution data were obtained for E_t=2.27, 3.24 and 5.95 MeV. The resulting a_2 and b_2 coefficients are compared to the predictions of a direct capture (cluster) model. This model gives a reasonably good description of the qualitative behavior observed in the experiment, although it predicts an absolute cross section which is an order of magnitude smaller than any observed cross section.

6514 Nuclear Properties And Reactions, A=20-38, Theoretical

27390 (CONF-8403101—4) Observation of a critical angular momentum for deep inelastic processes with light heavy ions. Thornton, S.T.; Parks, R.L.; Shapira, D.; Schull, D.; Ford, J.L.C. Jr.; Shivakumar, B. (Virginia Univ., Charlottesville (USA); Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02; 3; GPO Dep. Order Number DE84008580.

From 3. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (5 Mar 1984).

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Studies of collisions between nuclei have shown that the large incoming orbital angular momenta play an important role in systems where Coulomb and centrifugal repulsion for the dominant (near grazing) partial waves are of comparable magnitude (A/sub p/,A/sub t/ < 40). The kinetic energy of the fully damped fragments contains significant centrifugal energy contributions. Recent measurements have shown that the yield of fragments from strongly damped processes dominates the spectra at backward angles, and the angular distributions associated with this yield indicate that the fragments emerge from a long-lived rotating dinuclear complex (orbiting). These measurements at backward angles provide a means for studying the products from deep inelastic processes in the absence of contributions from quasielastic processes. In our study of deep inelastic processes in $^{28}Si + {}^{13}C$ at backward angles we show here results which demonstrate that the orbital angular momentum of the rotating dinuclear system formed in this collision reaches a critical value beyond which it ceases to increase with increasing bombarding energy.

27391 Beta-delayed two-proton decay of ^{26}P. Honkanen, J.; Cable, M.D.; Parry, R.F.; Zhou, S.H.; Zhou, Z.Y.; Cerny, J. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Chemistry). *Physics Letters,* [*Section*] *B;* **133**: No. 3/4, 146-148(15 Dec 1983).

Beta-delayed emission of two protons has been observed in the decay of ^{26}P. A two-proton summed energy group at 4.914 MeV was assigned to the decay to the ^{24}Mg ground state following the superallowed beta-decay of ^{26}P. The mechanism for two-proton emission has, in this case, been shown to be a sequential process.

27392 Scattering of polarized protons on ^{24}Mg, ^{27}Al, and ^{32}S and anomalies in the giant resonance region of ^{28}Al, of ^{29}Si, and of ^{33}Cl. Roy, R.; Lamontagne, C.R.; Slobodrian, R.J. (Laval Univ., Quebec City (Canada). Lab. de Physique Nucleaire); Arvieux, J.; Birchall, J.; Conzett, H.E. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Physics* [*Section*] *A;* **411**: No. 1, 1-16(12 Dec 1983). (In French).

Differential cross-section and analyzing power angular distributions have been measured for the elastic scattering of polarized protons on ^{24}Mg, ^{27}Al and ^{32}S between 13 and 27 MeV. An optical model analysis has been performed and the spin-orbit potentials display significant variations in the giant resonance region of ^{28}Al, ^{29}Si and ^{33}Cl. The ^{24}Mg and ^{32}S data have been examined in a phase-shift analysis.

27393 Resume and discussion of session on direct heavy ion reactions. Hansen, O. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics* [*Section*] *A;* **409**: 109-112(14 Nov 1983). (CONF-830340—).

From International conference on heavy-ion physics and nuclear physics; Catania, Italy (21 Mar 1983).

A conference divides into sessions, but the physics does not always respect such divisions. I found the subject of barrier penetrabilities viewed in a coupled channels picture new, exciting and central to all heavy-ion reaction dynamics. The subject was discussed in bits and pieces over three different sessions, partly in the talks by Winther, Landowne, Braun-Munzinger and Broglia, and partly from the floor by the same people and by Smilanski. I have concentrated on that subject alone and I therefore must apologize to the speakers in my session who covered different material, that definitely merited further discussions. Also, I apologize to other session chairmen, whose territory I have invaded.

27394 Excitation of giant spin-isospin multipole vibrations in sup(54,56)Fe and sup(58,60)Ni. Rapaport, J.; Taddeucci, T.; Welch, T.P. (Ohio Univ., Athens (USA)); Gaarde, C.; Larsen, J. (Niels Bohr Inst., Copenhagen (Denmark)); Horen, D.J. (Oak Ridge National Lab., TN (USA)); Sugarbaker, E.; Koncz, P. (Ohio State Univ., Columbus (USA)); Foster, C.C.; Goodman, C.D. (Indiana Univ., Bloomington (USA)). *Nuclear Physics* [*Section*] *A;* **410**: No. 3, 371-398(5 Dec 1983).

With 42 refs.

Data on (p,n) reactions at 120 and 160 MeV have been used to study the excitation of spin-isospin multipole vibrations in sup(54,56)Fe and sup(58,60)Ni. In particular, transitions characterized by L=0 transfer are identified as spin-isospin transitions (excitation of Gamow-Teller states) or as isospin transitions (excitation of isobaric analog states). An effort is made to estimate Gamow-Teller strength, B(GT), at excitation energies between 20-40 MeV. A comparison between GT and M1 strengths is presented for sup(58,60)Ni. Shell-model calculations for total strengths, ΣB(GT), are compared with the observed results.

27395 Nuclear structure approach to the Coulomb correction of the imaginary nucleon-nucleus optical potential. Osterfeld, F. (Kernforschungsanlage, Juelich, West Germany); Madsen, V.A. *Physical Review* [*Section*] *C: Nuclear Physics;* **24**: No. 6, 2468-2474(Dec 1981). Contract AM06-70RL02227.

The imaginary optical potentials for proton and neutron scattering have been calculated for ^{40}Ca using random phase approximation transition densities to describe intermediate states. Both inelastic and charge-exchange intermediate states are considered. The protons propagate in a nuclear-plus-Coulomb potential, and Coulomb excitation is included both for direct and exchange terms in the scattering amplitudes. Differences in the calculated neutron and proton optical potentials due to Coulomb excitation and isospin impurity of the random phase approximation states are found to be small. The expected exclusion of high-lying intermediate states by the Coulomb potential is present but it is compensated by a larger proton wave function in positive kinetic energy regions and by a more favorable local equivalent potential for protons.

27396 Scattering of MeV neutrons from elemental iron. Smith, A.; Guenther, P. (Argonne National Laboratory, 9700 South Cass Avenue Argonne, Illinois 60439). *Nuclear Science and Engineering;* **73**: No. 2, 186-195(Feb 1980).

Neutron elastic and inelastic scattering cross sections of elemental iron were measured from 1.5 to 4.0 MeV with incident neutron resolutions of ≦50 keV and at incident neutron energy intervals of ≦50 keV. Cross sections for the excitation of observed levels at 0.853, 1.389, 2.097, 2.579, 2.677, 2.974, and 3.152 MeV are determined. The observed elastic and inelastic scattering angular distributions fluctuate strongly with incident energy. The experimental results are averaged over broad energy intervals and are compared with the predictions of spherical optical statistical and coupled-channel models, including consideration of direct inelastic excitations. The importance of a comprehensive data base in such energy-averaged interpretations and in the evaluation of data for technological use is stressed.

27397 (DOE/ER/10434—5) High resolution positron q-value measurements and nuclear structure studies far from the stability line. Progress report, 1983-1984. Avignone, F.T. III. (South Carolina Univ., Columbia (USA). Dept. of Physics). 1 Mar 1984. Contract AS09-79ER10434. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007402.

Results of studies of the beta-delayed proton spectra of ^{147}Dy and ^{149}Er are presented, and a preliminary report on measuring the masses of ^{77}Kr and ^{75}Kr is given. Studies on the beta decay of ^{76}Rb and the level structure of ^{76}Kr and a search for axions from the 1.1155 MeV transition of ^{65}Cu are briefly described. (WHK)

27398 **(LA-UR—84-1293) Study of giant resonances with pions.** Baer, H.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 27p. (CONF-8403112—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011383.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

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Recent results on giant resonances obtained with pion-inelastic scattering and with single- and double-charge-exchange scattering are reviewed. The states discussed are isobaric analog states, double-isobaric analog states, and isovector L = 0, 1, and 2 collective states. 36 references.

6518 Nuclear Properties And Reactions, A=150-189, Theoretical

27399 **(LBL—17575) High-spin gamma-ray spectroscopy.** Diamond, R.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 19p. (CONF-8403112—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010716.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

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Nuclei can carry angular momentum by single-particle alignments and by collective motion, as has been well illustrated in discrete-line spectroscopy. From continuum γ-ray studies in still higher spin regions, it appears that these modes both continue. In favorable cases in rare-earth nuclei, particle alignments from the valence shell separate from proton alignments from the next higher shell. A new generation of Compton-suppressed Ge detector arrays will greatly enhance high-spin studies, both continuum and discrete-line. 17 references.

27400 **Aligned *v*isub(13/2) bands coupled to different shapes in ^{186}Hg.** Janssens, R.V.F.; Chowdhury, P.; Frekers, D.; Khoo, T.L.; Kuehn, W. (Argonne National Lab., IL (USA)); Emling, H. (Argonne National Lab., IL (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Chung, Y.H.; Daly, P.J.; Grabowski, Z.W. *Physics Letters, [Section] B;* **131**: No. 1-3, 35-39(10 Nov 1983).

The structure of ^{186}Hg has been studied through the ^{156}Gd(^{34}S,4n) reaction. Three bands with even spin and parity are observed; two of them are established up to high spin and are found to cross with little interaction at I=16$^+$. Cranked shell model calculations suggest that these two bands can be associated with a decoupled *v*isub(13/2) pair based on a prolate and on an oblate or triaxial shape, respectively.

27401 **Level scheme of ^{183}Re and systematics of odd-A Re isotopes. Interplay of epsilon$_2$ and epsilon$_4$ deformations in the W-Re region.** Brenner, D.S.; Barkey, D.; Blair, S. (Clark Univ., Worcester, MA (USA). Jeppson Lab. of Chemistry); Warner, D.D. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.); Meyer, R.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Physics [Section] A;* **408**: No. 2, 285-309(31 Oct 1983). Contract AC02-76CH00016;AC02-79ER10493;W-7405-ENG-48.

The levels of ^{183}Re populated in the decay of 13 h sup(183g)Os and 9.9 h sup(183m)Os have been studied using singles Ge(Li) detectors, a Compton-suppression spectrometer and a Ge(Li) γ-coincidence spectrometer. A detailed decay scheme has been developed with allows previously proposed Nilsson band assignments to be confirmed, and disagreements concerning assignments for the highly decoupled 1/2[541] band to be resolved. New Nilsson assignments are proposed as follows: 5+/2 5/2[642], 1040.7 keV; 1-/2[1/2[541], 0$^+$], 1414.7 keV; 3-/2[1/2[541],0$^+$], 1563.0 keV; 9-/2[9/2[514],0$^+$], 1711.7 keV. It is shown that the systematic behavior of the proton orbits throughout the odd-A Re isotopes can be understood in terms of the relative changes in epsilon$_2$ and epsilon$_4$ deformations, deduced from earlier studies of odd neutron nuclei in this region. However, while this analysis confirms the proposed peaking of the epsilon$_4$ deformation at N=108, a determination of the epsilon$_4$ value appropriate to ^{183}Re indicates that the absolute magnitudes of the hexadecapole deformations for odd-proton nuclei in this region are about a factor of two smaller than previously proposed for odd-neutron nuclei.

27402 **(ANU-P—861) Improved determination of the quadrupole moment of the first excited state of ^{208}Pb.** Spear, R.H.; Vermeer, W.J.; Esat, M.T.; Kuehner, J.A.; Baxter, A.M.; Hinds, S. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jun 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700904.

Microfiche only, copy does not permit paper copy reproduction6 refs.

Coulomb-excitation studies of the 3$^-$ first excited state of ^{208}Pb using ^{12}C and ^{16}O projectiles for a range of angles give -0.34 +- 0.15 e b for the static quadrupole moment and 0.611 +- 0.012 e^2 b^3 for B(E3; 0$^+$ $\rightarrow$ 3$^-$). The value obtained for the quadrupole moment is substantially more precise and reliable than previous determinations, and is larger in magnitude than theoretical predictions.

27403 **(LBL—15562) Identification of new astatine isotopes using the gas-filled magnetic separator, SASSY.** Yashita, S. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 69p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84007970.

Thesis.

A He-filled on-line mass separator system was built at the SuperHILAC and used to study the fusion products in the reaction ^{56}Fe + ^{141}Pr. The new neutron-deficient isotopes ^{194}At and ^{195}At were produced in this bombardment as three- and two- neutron-out products, respectively, and were identified by the α-α time-correlation technique. The measured α energies and half lives are 7.20 +- 0.02 MeV and 180 +- 80 msec for ^{194}At, and 7.12 +- 0.02 MeV and 200 +- 100 msec for ^{195}At. 66 references.

27404 **In-beam study of ^{213}Rn, ^{215}Ra and ^{217}Ra: strongly enhanced E3 transitions in odd-A N = 127 isotones.** Loennroth, T.; Baktash, C. (Brookhaven National Lab., Upton, NY (USA)). *Physica Scripta;* **28**: No. 4, 459-466(Oct 1983).

With the aim of searching for high-spin configurations involving the high-j neutron orbitals, excited states in ^{213}Rn, ^{215}Ra and ^{217}Ra were populated in the bonbardment of ^{208}Pb with ^{13}C ions. Gamma-ray singles, excitation functions and angular distributions, pulsed-beam-γ timing and γ-γ(t) coincidences were measured. Six isomeric levels were observed in ^{213}Rn, three in ^{215}Ra while none in ^{217}Ra. The lowest-lying 15/2$^-$ states in all odd-A N = 127 isotones are de-excited by E3 transitions with a strength of about 23 W.u. suggesting that they are all coupled to the octupole phonon. In ^{217}Ra no evidence for collective behavior is found despite its closeness to the actinide region. The low-lying states in the level scheme can be interpreted as arising from three-neutron configurations. The wave function of a Jsub(π)=(37/2$^+$) state in ^{213}Rn is proposed to include about 30% admixture from the two-octupole configuration πhsub(9/2)^{3}fsub(7/2)Xγgsub(9/2)X(3$^-$)^3 since the de-exciting E3 transition has a strength of about 40 W.u. This is the first indication of such an excitation in the lead region.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

27405 **(GSI—83-12) Dynamical features of Coulomb-fission.** Schukraft, J.G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1983. 116p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751266.

Fission following quasielastic scattering was investigated in the reactions ^{208}Pb -> ^{238}U below the Coulomb Barrier and 7.5 MeV/u ^{238}U -> ^{238}U at scattering angles forward of the grazing angle (87°). A kinematically complete analysis of 3-body coincidences was carried out measuring position and time-of-flight of the scattered projectile-like particle and 2 fission fragments in large parallel plate detectors. In the reaction ^{208}Pb -> ^{238}U, measured at backward angles, the slope of the differential cross section at 5.4 MeV/u is in qualitative agreement with the theoretical expectation

for Coulomb-fission. The angular distribution of the fission fragments, measured with respect to the semisector axis (apex line towards the projectile), is close to 1/sinTHETA and does not show any of the significant structures predicted by several theories. The anisotropy is smaller in all other coordinate systems investigated. The fission probability in the reaction $^{238}U \rightarrow ^{238}U$, measured down to $5x10^{-4}$ at THETAsub(cm)=54° (corresponding to 75% Esub(cb) at the distance of closest approach) as well as the low excitation energy < 11 MeV, determined from the fission fragment mass distribution, behave at scattering angles <75° as expected for Coulomb-fission. The absence of a detectable final state Coulomb interaction yields a lower limit of $1\text{-}2x10^{-20}$s for the lifetime of the fissioning nucleus.

27406 **Evidence for near-stable octupole deformation in ^{225}Ra.** Sheline, R.K. (Australian National Univ., Canberra. Research School of Physical Sciences; Florida State Univ., Tallahassee (USA)); Decman, D. (Florida State Univ., Tallahassee (USA)); Nyboe, K.; Thorsteinsen, T.F.; Loevhoeiden, G. (Bergen Univ. (Norway)); Flynn, E.R.; Cizewski, J.A. (Los Alamos Scientific Lab., NM (USA)); Burke, D.K. (McMaster Univ., Hamilton, Ontario (Canada)); Sletten, G. (Niels Bohr Inst., Copenhagen (Denmark)). *Physics Letters, [Section] B;* **133**: No. 1/2, 13-16(8 Dec 1983).

The low lying level structure of ^{225}Ra, studied with the ^{226}Ra(d,t) reaction and ^{225}Fr β-decay, has approximately degenerate K=1/2sup(+-) and K=3/2sup(+-) bands. Hybrid absolute values of the decoupling parameters of the K=1/2sup(+-) bands, intermediate between the theoretical values expected for the pure Nilsson configurations, are deduced and presented as evidence for near-stable octupole deformation in the ^{225}Ra ground state.

27407 **Nuclear structure of ^{225}Ra.** Nyboe, K.; Thorsteinsen, T.F.; Loevhoeiden, G. (Bergen Univ. (Norway)); Flynn, E.R.; Cizewski, J.A. (Los Alamos Scientific Lab., NM (USA)); Sheline, R.K.; Decman, D. (Florida State Univ., Tallahassee (USA)); Burke, D.G. (McMaster Univ., Hamilton, Ontario (Canada)); Sletten, G. (Niels Bohr Inst., Copenhagen (Denmark)); Hill, P. *Nuclear Physics [Section] A;* **408**: No. 1, 127-149(24 Oct 1983).

The level structure of ^{225}Ra has been studied using the (d, t) reaction with both unpolarised and polarised deuterons and the β^- decay of ^{225}Fr. Cross sections and excitation energies have been measured for 41 levels below 1800 keV in the (d, t) reaction, and levels up to 724 keV have been established from the β^- decay measurements. The level structure is interpreted in terms of the Nilsson model.

6530 Nuclear Theory

27408 **(GSI—83-36-Prepr.) Dynamical single-particle basis in large-amplitude nuclear motion.** Cassing, W.; Wang, S.J.; Noerenberg, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1983. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751265.

Various approximations with respect to the solution of the time-dependent single-particle Schroedinger equation depending on a collective parameter q(t) are investigated. A travelling diabatic s.p. basis is found to provide a good and convenient approximation for a rather wide regime of collective energies per nucleon. Numerical calculations are performed for quadrupole vibrations within the deformed harmonic oscillator model as well as for central heavy-ion collisions in a diabatic two-center shell-model.

27409 **(IC—83/26) Comparison of model Hartree-Fock type calculation schemes involving various non-degenerate and quasi-degenerate intrinsic Hamiltonians.** Amusa, A. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700901.

Different Hamiltonians and their corresponding rotationally degenerate intrinsic counterparts are employed in the study of ^{18}O nucleus under the normal Hartree-Fock, as well as under six other Hartree-Fock type variational calculation schemes. The results are compared and then assessed in the light of their closeness or otherwise to the full 1s-0d basis shell model calculations for this nucleus. The use of these schemes for other shells is also considered.

27410 **(LA-UR—84-761) Nuclear inertia for fission in a generalized cranking model.** Kunz, J.; Nix, J.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-8403101—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010063.

From 3. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (5 Mar 1984).

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The Inglis cranking model has been widely used to calculate the nuclear inertia associated with collective degrees of freedom. After the inclusion of pairing correlations, theoretical results obtained with the cranking model for nuclear rotations and γ-vibrations were in relatively good agreement with experimental data. Calculations of β-vibrational inertias were also performed in the cranking model for fission deformations. Theoretical results were several times the irrotational values and gave reasonable agreement with experimental spontaneous-fission lifetimes, although in one study a renormalization factor of 0.8 was required. However, as pointed out by many authors, the Inglis cranking model possesses two serious deficiencies. First, problems arise when the single-particle potential contains momentum-dependence terms. Second, in the limit of large pairing strength the inertia approaches zero instead of a finite (irrotational) limit. Alternative approaches to the cranking model which did not lead to such unacceptable results were developed by Migdal, Belyaev and Thouless and Valatin. They showed that these deficiencies of the cranking model are due to a lack of self-consistency, since the reaction of the mean field to the collective motion is neglected in the Inglis model. Previously we used their arguments and developed a generalized cranking model for stationary collective motion. Here it is shown how to develop a time-dependent formalism appropriate to β-vibrations and fission. 10 references.

27411 **(LA-UR—84-823) High energy nuclear structures.** Boguta, J.; Kunz, J. (Lawrence Berkeley Lab., CA (USA); Los Alamos National Lab., NM (USA)). 9 Mar 1984. Contract W-7405-ENG-36. 5p. (CONF-8403101—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010062.

From 3. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (5 Mar 1984).

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In conventional nuclear physics the nucleus is described as a non-relativistic many-body system, which is governed by the Schroedinger equation. Nucleons interact in this framework via static two-body potentials, mesonic degrees of freedom are neglected. An alternative description of nuclear physics in terms of a relativistic field theory has been developed by Walecka. The model Lagrangian containing baryons, σ-mesons and ω-mesons was subsequently extended to include also π-mesons and rho-mesons. An essential feature of such a nuclear Lagrangian is its renormalizability. In addition to the description of known nuclear structure the field theoretical approach may reveal entirely new nuclear phenomena, based on the explicit treatment of mesonic degrees of freedom. The existence of such abnormal nuclear states was proposed by Lee and Wick employing the σ-model Lagrangian. There the non-linearity of the meson field equations allows for soliton solutions in the presence of nucleons, in particular the σ-field may exhibit a kink. Different types of soliton solutions occur in gauge theories with hidden symmetries. In the phenomenological Lagrangian the rho-meson is described by a non-abelian gauge field, that acquires its mass spontaneously due to the non-vanishing vacuum expectation value of a Higgs field. A general ansatz for soliton solutions of such a gauge theory was given by Dashen et al. A specific solution and its possible implications for nuclear physics like anomalous nuclear states were discussed by Boguta.

27412 **Comment on J-dependence in (α,d) transfer reactions.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)); Pinkston, W.T. (Oak Ridge National Lab., TN (USA); Vanderbilt Univ., Nashville, TN (USA)). *Physics Letters, [Section] B;* **134**: No. 1/2, 7-10(5 Jan 1984).

We examine the structure of the second-order distorted-waves Born approximation amplitude for the two-nucleon (α, d) transfer reactions. It is found that the sign of the interference between simultaneous and sequential transfer amplitudes cannot depend upon the value of the total angular momentum transfer J within the context of the model that is usually assumed. This contradicts calculations reported recently for the (α, d) reaction. Since the observed cross sections do show an even-odd dependence on J, we conclude that the usual model is inadequate.

27413 **Flow patterns for collective quadrupole vibrations in heavy nuclei.** Schuh, A. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Washington Univ., Seattle (USA). Inst. for Nuclear Theory; Washington Univ., Seattle (USA). Dept. of Physics); Kunz, J. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Los Alamos National Lab., NM (USA). Theoretical Div.); Mosel, U. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). *Nuclear Physics* [*Section*] *A;* **412**: No. 1, 34-60(2 Jan 1984).

With 31 refs.

By means of the adiabatic cranking model the properties of the current and velocity fields of nuclear quadrupole vibrations for even-even nuclei in the rare-earth region are investigated. BCS correlated wave functions based on the Nilsson single-particle hamiltonian have been used. The current fields are analyzed in terms of vector spherical harmonics. The realistic microscopic currents show a vortex structure not present in the classical irrotational flow. The microscopic origin of the vortex structure is investigated. Whereas irrotational flow is related to high-lying excitations, the vortical current is shown to represent low-lying excitations. The influence of pairing is demonstrated; high pairing gaps yield nearly irrotational flow. The effect of deformation is studied. The cranking-model velocity fields are compared with the results of classical first and zero sound calculations and are found to agree with the latter in important aspects.

27414 **Effects of magnetic monopoles on nuclear wave functions and possible catalysis of nuclear beta decay and spontaneous fission.** Lipkin, H.J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics; Argonne National Lab., IL (USA). Physics Div.; Argonne National Lab., IL (USA). High Energy Physics Div.; Fermi National Accelerator Lab., Batavia, IL (USA)). *Physics Letters,* [*Section*] *B;* **133**: No. 5, 347-350(22 Dec 1983).

Mixing effects in nuclear wave functions by the strong magnetic field of a magnetic monopole are estimated. A monopole at a distance of 10 fm from a deuteron mixes the singlet and triplet spin levels with a strength comparable to the deuteron binding energy. Forbidden nuclear beta decay transitions can be enhanced by mixing nuclear wave functions with other states for which the beta decay transition is less inhibited. Particularly suitable candidates have nearby excited states connected by magnetic dipole transition to the ground state. Magnetic mixing can also strongly enhance spontaneous fission.

27415 **Properties of the transition amplitude for two-nucleon transfer reactions.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)); Pinkston, W.T. (Vanderbilt Univ., Nashville, TN (USA); Oak Ridge National Lab., TN (USA)). *Nuclear Physics* [*Section*] *A;* **411**: No. 1, 144-150(12 Dec 1983).

A general discussion is given of the angular momentum structure of the transition amplitude for two-nucleon transfer, particularly in light-ion-induced reactions. For example, it is shows that, within the model which is usually assumed, the relative phase between simultaneous and sequential transfer parts of the amplitude, for a given two-nucleon configuration, cannot depend upon the value of J, the total angular momentum transfer. A dependence on the oddness or evenness of J can emerge when there are additional sources of angular momentum transfer. Some of these are indicated.

27416 **Relativistic nuclear structure physics.** Anastasio, M.R. (City Univ. of New York, NY (USA). Dept. of Physics; City Univ. of New York, NY (USA). Inst. for Nuclear Theory; California Univ., Livermore (USA). Lawrence Livermore National Lab.); Pong, W.S. (City Univ. of New York, NY (USA). Dept. of Physics; City Univ. of New York, NY (USA). Inst. for Nuclear Theory; Gerber Systems Technology, Windsor, CT (USA)); Celenza, L.S.; Shakin, C.M. (City Univ. of New York, NY (USA). Dept. of Physics; City Univ. of New York, NY (USA). Inst. for Nuclear Theory). *Physics Reports: A Review Section of Physics Letters (Section C);* **100**: No. 6, 327-392(Dec 1983).

With 100 refs.

We review a recently developed model of nuclear structure, and discuss the binding energy and saturation properties of nuclear matter, the density and momentum-transfer dependence of the effective force in nuclei and the parameters of a relativistic optical model. The model we describe is free of parameters other than those introduced in fitting free-space nucleon-nucleon scattering data. In contrast to standard models, the relativistic formulation is able to give a satisfactory description of the saturation properties of nuclear matter. The mechanism responsible for saturation in the relativistic model also accounts for the strong density dependence of the scalar-isoscalar part of the effective nuclear interaction found in phenomenological studies. The calculated values of the self-energy of a continuum nucleon in nuclear matter may also be used to estimate the parameters of the optical potentials used to fit nucleon-nucleus scattering data. Estimates based upon the local-density approximation are successful in reproducing both the energy and density dependence of the phenomenological potential.

27417 **Nucleus-nucleus potentials.** Satchler, G.R. (Oak Ridge National Lab., TN (USA). Physics Div.). *Nuclear Physics* [*Section*] *A;* **409**: 3-20(14 Nov 1983). (CONF-830340—).

From International conference on heavy-ion physics and nuclear physics; Catania, Italy (21 Mar 1983).

With 59 refs.

The significance of a nucleus-nucleus potential is discussed. Information about such potentials obtained from scattering experiments is reviewed, including recent examples of so-called "rainbow" scattering that probe the potential at smaller distances. The evidence for interactions involving the nuclear spins is summarized, and their possible origin in couplings to non-elastic channels. Various models of the potentials are discussed.

27418 **Phenomenology of deep-inelastic processes.** Moretto, L.G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). *Nuclear Physics* [*Section*] *A;* **409**: 115-134(14 Nov 1983). (CONF-830340—). Contract AC03-76SF00098.

From International conference on heavy-ion physics and nuclear physics; Catania, Italy (21 Mar 1983).

With 40 refs.

The field of heavy-ion deep-inelastic reactions is reviewed with particular attention to the experimental picture. The most important degrees of freedom involved in the process are identified and illustrated with relevant experiments. Energy dissipation and mass transfer are discussed in terms of particles and/or phonons exchanged in the process. The equilibration of the fragment neutron-to-proton ratios is inspected for evidence of giant isovector resonances. The angular momentum effects are observed in the fragment angular distributions and the angular momentum transfer is inferred from the magnitude and alignment of the fragments spins. The possible sources of light particles accompanying the deep-inelastic reactions are discussed. The use of the sequentially emitted particles as angular momentum probes is illustrated. The significance and uses of a thermalized component emitted by the dinucleus is reviewed. The possible presence of Fermi jets in the prompt component is shown to be critical to the justification of the one-body theories.

27419 **Coulomb effects in nuclear structure.** Auerbach, N. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy; Los Alamos National Lab., NM (USA)). *Physics Reports: A Review Section of Physics Letters (Section C);* **98**: No. 5, 273-341(Sep 1983).

With 114 refs.

A large class of nuclear structure phenomena and properties stemming from the action of the Coulomb force is reviewed. The isobaric multiplet mass equation, isospin forbidden decays, isospin mixing, Coulomb displacement energies, and widths of isobaric analog resonances are considered. The role of the isovector monopole resonance as a mediator of second-order Coulomb effects contributing to all the above phenomena is discussed in detail.

6540 Radiation And Shielding Physics

27420 (DL/SCI/R—19, pp 66-71) **X-ray diffraction using the time structure of the SRS.** Tanner, B.K. (Durham Univ. (UK). Dept. of Physics). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The subject is discussed under the headings: introduction (advances in the techniques of X-ray topography; comparison with transmission electron microscopy); stroboscopic X-ray topography; stroboscopic X-ray topography of travelling surface acoustic waves; possible general diffraction experiments.

27421 (DL/SCI/R—19, pp 84-86) **Ultra-high resolution small-angle x-ray diffractometry: measurements of very large periods in biological fibres.** Siddons, D.P.; Deutsch, M. (King's Coll., London (UK). Wheatstone Physics Lab.); Nave, C. (Daresbury Lab. (UK)); Bradshaw, J. (Oxford Univ. (UK). Dept. of Zoology). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

The technique of small-angle x-ray scattering using a synchrotron source is described. Improved instrumentation is shown, using multiple-reflection crystal monoliths as high-quality collimators. A small-angle diffraction pattern from frog Sartorius muscle, using the improved apparatus, is shown.

27422 **(EFI—595(82)-82) Numerical simulation of trajectories and characteristics of high energy particle radiation in averaged potential of crystal axes.** Avakyan, A.R.; Glebov, V.I.; Goloviznin, V.V.; Zhevago, N.K.; Yan Shi. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 38p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701397.

The numerical simulation is carried out of the motion of high energy electrons and positrons in the averaged potential of the monocrystal axes which is the sum of potentials of separate axes with given Miller indices calculated in the Moliere-Appleton model. Characteristic trajectories of particles of various types are presented corresponding to the true channeling and quasichanneling cases. Distributions of particles in angles of exit from the crystal are presented and analyzed.

27423 **(EFI—610(97)-82) Photon asymmetry in coherent bremsstrahlung of polarized electrons.** Darbinyan, S.M.; Oganesyan, K.M. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701398.

The bremsstrahlung cross section of high energy polarized electrons in crystals is calculated taking account of the primary electron spin dependent Born corrections of the order $Z\alpha$. It is shown that in crystals the dependence of the cross section on the particle spin results in the asymmetry not only it the photon angular distribution but also in the total cross section integrated over the angles of the final particles that is connected with the discrete nature of momentum transfers. The calculations are carried out for electrons with arbitrary polarization taking account of the thermal vibration of the lattice atoms.

27424 **(EIR—443) Optimized broad energy group structures for radiation transport in air and in LWR-shields.** Herrnberger, V.; Padiyath, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Oct 1981. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700899.

Basic ideas of the automatic group collapsing scheme AGRUKO are briefly described. The errors introduced by the collapsing process are controlled by criteria, which are constructed by the sensitivity profiles and the required target accuracies of the specific shielding type configurations. The group widths are optimized to reduce the calculation time with respect to the fine group calculations. Optimized group structures were generated for two rather different shielding benchmarks: Neutron and gamma transport in a LWR-shield and in air using a fusion source respectively. In the case of the LWR-shield the 100/20 groups EURLIB-3 structure was collapsed to 45/16 and 15/5 groups. In the case of the "air" problem the original 22/18 groups were collapsed to 4/8 groups. The accuracies achieved were in general within the required accuracies for the targets thermal flux (activation), radiation damage, radiation heating and dose rates. Because the broad group structures were optimized in view of basic physical and numerical principles, they are nearly free from arbitrary assumptions as constant lethargy width e.g. Therefore they may be recommended for further use in the field of more complex transport calculations or cross section adjustment procedures.

27425 **(EIR—459) FINELM: a multigroup finite element diffusion code. III. R-theta geometry and internal boundary conditions.** Pelloni, S.; Higgs, C.; Davierwalla, D. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1982. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700958.

The authors describe the formalism of the finite element for r-theta geometry. The treatment of a four sided element with two circular arcs and two radial sides is presented. At the centre of the disc this element is collapsed into a three sided element by reducing the inner arc length to zero. The singularity of the leakage term of such an element at $r=0$ is described. The modelling of control and safety rods by introducing boundary conditions interior to the reactor is presented. This has the effect of converting the diffusion region from a simply connected to a multiply connected region. Dirichlet conditions with prescribed flux values zero are imposed on nodes in the interior of the non diffusion zones in order to decouple these nodes from the rest. The method is tested by calculating the effectiveness of control and safety rods for a 500 MW Th high temperature reactor. The results are compared with those obtained with DIFGEN using x-y geometry. The DIFGEN results and the problem data are by courtsey of Hochtemperatur Reaktor Bau AG, Mannheim.

27426 **(EIR—466) Integral methods for handling the slit problem in the reactor shield.** Dupont, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1982. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84701453.

Concerning neutron streaming in the reactor shield, the author develops a mathematical model for the handling of slit problems and other split-formed-cavity problems. Originating from the integral form of the Boltzmann equation a description of the angle dependence (using spherical functions) and the spatial dependence (using Legendre polynomials) for the neutron flux density in square meshes of the solution is given. The Boltzmann equation is solved using the Ssub(n)-method, using a full discretisation of the angle and spatial dependencies. The solution can have two variations, and these can be obtained using the DP0MIS and DP1MIS programs.

27427 **(EUR—8420) MORSE-E1, source and analysis routines to be used with the MORSE code.** Ponti, C.; Heusden, R. van. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700959.

This report describes the content and the use of a set of source and analysis routines to be used with the MORSE code.

Uniformly distributed sources within simple geometrical shapes are implemented in the package. It calculates the flux of particles as the sum of the path travelled within a given volume; the corresponding relative errors are also provided. Particle currents through surfaces may also be computed. The MORSE-E1 package enables the user to solve many problems without further programming work.

27428 **(JINR—E-3-82-849) Slow neutron scattering on bismuth and lead and electric polarizability of the neutron.** Aleksandrov, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1982. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701454.

The paper reviews experimental data reported in literature on neutron interaction with nuclei of bismuth and lead in the energy range up to 200 keV. Least-square analysis data yields the coefficient of electric polarizability of the neutron: $(13+-8)x10^{-42}$ cm^3 (eV range of the neutron energies) and $(6+-3)x10^{-42}$ cm^3 (keV range of the neutron energies).

27429 **(JINR—R-1-83-294) Coherent bremsstrahling and radiation of relativistic papticles channeling in crystals.** Zimin, N.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701400.

Spectra of radiation for electrons (positrons) moving inside a crystal have been calculated uSing the Coherent bremsstrahlung theory. The calculations have been made for channeled and quasi-channeled particles taking into account incident beam angular divergenve. It is shown that the coherent bremsstahlung theory cannot describe. the radiation of relativistic channeled particles correctly. For nonchanneled particles the coherent bremsstrahlung intensity can exceed the incoherent radiation in a crystal by a factor of dozens.

27430 **(JINR—R-14-83-102) Proportionality between the structure factor and the intensity of the diffractional neutron scattering on mosaic crystal.** Kim Cnir Sen; Kubiak, S.; Nitts, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1983. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701455.

The neutron scattering on a large-scale blocked mosaic crystal is considered in the framework of the dynamic theory of diffraction. It is shown that the proportionality between the intensity of scattering and structurai factor should take place if the Bragg angle is close to 90 deg. This circumstance could be used when choosing optimal conditions for neutronographical investigations.

27431 **(JINR—R-17-83-291) Radiation peak of 1-10 GeV positrons chenneling in Si.** Adam, G.; Adam, S.; Gavrilenko, G.M.; Mikhalake, D.; Fedyanin, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 3p. (In Russian). (CONF-8305173—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701401.

From 23. conference on physics of interaction of charged particles with crystals; Moscow, USSR (1 May 1983).

The spectral intensity of the first dipole harmonics is evaluated within the quantum mechanical approach to the solution of the channeling radiation problem, with a realistic choice of the effective planar potential. The effects of anharmonicity and non-dipolarity are investigated for various momenta of the incident positrons (110) planar channeled in Si and it is concluded that a very intense and narrow emission of γ-radiation at Esub(γ)=13.5 MeV is expected to occur for 3 GeV/c positrons.

27432 **(KFTI—82-40) Dynamics of relativistic electrons(positrons) in a crystal.** Morokhovskij, V.L. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701402.

On the basis of the solid-state theory methods, a convenient technique is developed for numerical solving of the Dirac equation for relativistic electrons (positrons) in the three-dimensional statistic potential of a crystal. The dynamics of relativistic electrons (positrons) in the crystal without an account for inelastic processes is considered in a supposition that the crystal fills the semi-space, whereas the momentum of the incident particle is directed normally to the flat vacuum-crystal boundary at a small angle to one of the main crystallogaphic directions.

6550 Medical Physics

27433 **(LA—9979-MS) In vivo assessment of lung burdens at the Los Alamos National Laboratory.** Vasilik, D.G.; Aikin, I.C.; Coop, K.L.; Umbarger, C.J. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011012.

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The Los Alamos National Laboratory program for in vivo measurements includes the capability for the assessment of plutonium and americium lung burdens. This capability is an important part of the health and safety program at Los Alamos where a wide variety of radioisotopes are utilized. This report addresses the lung burden assessment portion of our in vivo measurement capabilities. Lung burden measurements at Los Alamos make use of a twin phoswich detector system placed over the lungs of a prone subject. Analysis results are interpreted in terms of two basic statistical measures of detection limits. One measure is called the minimum significant measured activity (MSMA), which is interpreted as meaning that there is some activity in the lungs. The second measure is called the minimum detectable true activity (MDTA), which is defined as the smallest amount of activity required to be in the lungs in order that a measurement of an individual can be expected to imply, correctly, the presence of activity with a predetermined degree of confidence.

27434 **Applying the reciprocal dose principle to heterogeneous phantoms: practical experience from Monte Carlo studies.** Cristy, M. (Oak Ridge National Lab., TN (USA)); Williams, L.R. (Indiana Univ., South Bend (USA). Dept. of Mathematics). *Physics in Medicine and Biology;* **28**: No. 11, 1289-1303(Nov 1983).

The reciprocity theorem states that for any pair of regions in a uniform isotropic or uniform scatterless model, the specific fraction (PHI) is independent of which region is designated source and which is designated target. Although the conditions of these models are not met by phantoms heterogeneous in tissue composition and density, calculations with a Monte Carlo radiation transport code show that in many cases the reciprocal PHIs from photon radiation are approximately equal. This 'reciprocity principle' is valid within a factor of 2(Snyder) or about 20% (Mayneord and Clarke), except when one of the organs in the pair considered is the skeleton, where the reciprocal PHIs may differ by as much as a factor of 4. The principle holds within at least 10% when both organs are of near-unit-density. When one of the organs is near the tissue-vacuum boundary (skin, breasts, or testes), reciprocal PHIs may differ by as much as 10% or so at energies where scattering is marked. When one of the organs is the lungs or the whole body, a comparable error may occur at some energies.

27435 **Measurement of Wsub(N)/e for methane-based tissue-equivalent gas in a d(4)-Be neutron field.** Maughan, R.L.; Michael, B.D. (Mount Vernon Hospital, Northwood (UK). Gray Lab.); McDonald, J.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)); Ma, I.C. (Memorial Sloan-Kettering Cancer Center, New York (USA)). *Physics in Medicine and Biology;* **28**: No. 1, 1105-1112(Oct 1983).

Measurements of absorbed dose were carried out in a d(4)-Be neutron field using tissue-equivalent (TE) plastic ionisation chambers and a TE plastic calorimeter in a TE plastic phantom. The γ-ray dose fraction at the same position was measured using two types of Geiger-Mueller (GM) dosemeters. Good agreement was found in the absorbed dose as determined by the use of the two types of ionisation chambers: spherical and thimble-shaped. Bragg-Gray theory was employed, along with measurements using the ionisation chambers and the calorimeter to compute a value for

the ratio of absorbed dose to specific charge, which is proportional to the product of the stopping power ratio for secondary charged particles in the chamber wall and gas (Ssub(w,g)sub(N), and the average energy expended in the gas per ion pair formed (Wsub(N)/e). The value of Wsub(N)/e) for the d(4)-Be field studied was found to be 31.0 +- 1.8 J C^{-1} for methane-based TE gas, assuming the stopping power ratio to be 1.000 +- 0.044 for neutrons.

27436 **Neutron fluence-to-dose equivalent conversion factors: a comparison of data sets and interpolation methods.** Sims, C.S.; Killough, G.G. (Oak Ridge National Lab., TN (USA)). *Radiation Protection Dosimetry;* **5**: No. 1, 45-48(1983).

Various segments of the health physics community advocate the use of different sets of neutron fluence-to-dose equivalent conversion factors as a function of energy and different methods of interpolation between discrete points in those data sets. The major data sets and interpolation methods are used to calculate the spectrum average fluence-to-dose equivalent conversion factors for five spectra associated with the various shielded conditions of the Health Physics Research Reactor. The results obtained by use of the different data sets and interpolation methods are compared and discussed.

6560 Solid State Physics

27437 **(BNL—34604) Photoemission studies of mixed valent systems.** Parks, R.D.; Raaen, S.; denBoer, M.L.; Williams, G.P. (Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 23p. (CONF-840264—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010797.

From Workshop on high energy excitations in condensed matter; Los Alamos, NM, USA (13 Feb 1984).

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Photoemission spectroscopy has been used to study a number of aspects of the mixed valent state (corresponding to non-integral 4f occupation) in rare earth systems. Deep core photoemission (e.g., from 3d or 4d levels) allows the measurement of the 4f occupancy and surface valence shifts, and, as well, the indirect measurement of the effect of solid state environment on the energy of hybridization between 4f electrons and conduction electrons. 4f-Derived photemission has been used to study surface valence and chemical shifts and to infer the nature of the mixed valent ground state. A combination of 4f-derived photoemission and add-electron spectroscopy provides a measurement of the 4f Coulomb correlation energy, an important parameter in the mixed valent problem. A review of these approaches is presented, with emphasis on Ce-based systems, whose behavior falls outside the usual description of 4f-unstable systems. 35 references.

27438 (DL/SCI/R—19, pp 44-46) **Energy dispersive X-ray diffractometry in texture studies.** Szpunar, J.A. (Durham Univ. (UK). Dept. of Physics). 1983. NTIS (US Sales Only), PC A06/MF A01. (CONF-8211147—).

From Daresbury study on application of synchrotron radiation to problems in materials science; Daresbury, UK (13 Nov 1982).

Information about texture is traditionally obtained from the two-dimensional distributions of crystallographic directions in the reference frame of the specimen. The distributions can be measured using the angular dispersive diffractometry. In such measurements the rotation of the specimen brings the crystallographic planes of differently oriented crystals into the diffraction position. The distribution (pole figure) can be measured continuously or alternatively the angular space can be scanned in different directions and with required accuracy. The subject is discussed, with examples.

27439 **(EFI—588(75)-82) Investigation of bent monocrystals structural perfection using synchrotron radiation diffraction peculiarities.** Karabekov, I.P.; Egikyan, D.L.; Mikaelyan, L.A.; Bagdasaryan, V.G.; Martirosyan, M.A.; Kotsinyan, A.M.; Khachikoghlyan, S.L. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701396.

The results of the investigation of synchrotron radiation (SR) diffraction peculiarities from distorted monocrystalline plates are presetned. The possibilities of SR diffraction peculiarities for the definition of monocrystals structural perfection are discussed.

27440 **(JINR—E-17-83-293) Electron-phonon interaction and the generalized kinetic equation for systems interacting with high-intensity electromagnetic wave fields.** Vo Hong Anh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701367.

The generalized kinetic equation for an electron-phonon system subjected to the action of an intense electromagnetic wave field is derived on the basis of the Bogolubov method of elimination of boson operators, taking into account the electron-phonon collision effects. The conditions are considered under which the collision integral allows the introduction of the relaxation time, and the latter is calculated as a function of the frequency and intensity of the pumping field.

27441 **(MLM—3139(OP)) NMR studies of electronic structure and hydrogen diffusion in transition metal hydrides.** Bowman, R.C. Jr. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 36p. (CONF-840152—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009863.

From International workshop on hyperfine interactions; Kanpur, India (16 Jan 1984).

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Nuclear magnetic resonance spectroscopy has had extensive applications for the characterizations of numerous metal-hydrogen systems. Although the greatest emphasis of proton NMR has been to evaluate diffusion behavior, increasing attention has been addressed upon the correlation of proton Knight shifts and the conduction electron contributions to proton spin-lattice relaxation times to the electronic structure properties of the hydride. The general principles of NMR that pertain to the usual situations for most transition metal hydrides will be briefly reviewed. Several specific examples from some recent research will be discussed in greater detail. In particular, the roles of host crystal structure and hydrogen site occupancy to hydrogen diffusion behavior are examined for the Ti/sub 1-y/Cu/sub y/H/sub x/ and Zr/sub 1-y/Pd/sub y/H/sub x/ systems. The proton hyperfine parametes in TiH/sub x/ and ZrH/sub x/, as well as several related ternary hydrides, are used to qualitatively assess the character of the Fermi level electronic states. The relationship between the tetragonal distortions of the Ti and Zr dihydrides and a solid-state Jahn-Teller mechanism will also be examined.

27442 **(UCRL—15587) Formulation and numerical integration of elastoplastic and elasto-viscoplastic rate constitutive equations.** Pinsky, P.M.; Pister, K.S.; Taylor, R.L. (Brown Univ., Providence, RI (USA). Div. of Engineering; California Univ., Berkeley (USA). Dept. of Civil Engineering). Aug 1982. Contract W-7405-ENG-48. 35p. (UCB/SESM—82/05). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010991.

Spatial rate constitutive equations for elastoplastic and elasto-viscoplastic materials are considered within a thermodynamic framework in which irreversible processes are characterized through the use of internal state variables and in which no restrictions on the magnitude of the deformation are imposed. The development employs an invariance principle which leads to a unique definition of the objective rate appearing in the rate constitutive equations. The elastic-plastic split of the deformation is introduced through a thermodynamic argument which leads to the additive decomposition of the spatial rate of deformation tensor. Following the development of the rate constitutive equations, a numerical algorithm is presented for their numerical integration. By employing product formula techniques, the proposed algorithm exploits the operator split of the spatial rate constitutive equations resulting from the additive decomposition of the rate of deformation tensor. The resulting algorithm is demonstrated to be unconditionally stable and incrementally objective. Finally, an efficient and very accurate implicit global algorithm for the numerical solution of the initial boundary value problem of linear momentum balance in con-

junction with the product algorithm for the constitutive equations is proposed. Numerical examples illustrate the effectiveness of the procedure.

27443 **Photostimulated field emission - image rounded barrier model.** Schwartz, C.; Cole, M.W. (Pennsylvania State Univ., University Park). *Surface Science;* **115**: 290-300(1982). Contract AC02-79ER10454.

A theory of photostimulated field emission (PFE) is presented which is analogous to that of the surface effect in photoemission. The authors generalize and extend previous calculations of Bagchi and Taranko. Results are compared with data of Lee and Reifenberger. The theory does not yield the observed oscillatory dependence of the current as a function of applied field.

27444 **Monte Carlo simulation of the two-dimensional classical Heisenberg model with easy-plane anisotropy.** Kawabata, C. (Okayama Univ. Computer Center, Japan); Bishop, A.R. *Solid State Communications;* **42**: No. 8, 595-600(1982).

Monte Carlo simulation results are presented for the classical, two-dimensional ferromagnetic Heisenberg model with 1% easy-plane anisotropy. Evidence for a Kosterlitz-Thouless-like topological phase transition at T = T/sub KT/ is presented with T/sub KT/ ~= 2/3 T/sub KT/ (planar). A specific heat anomaly is observed at T = T/sub S/ with T/sub S/ slightly above T/sub KT/. The in-plane spin-component correlations decay exponentially for T > T/sub KT/. The out-of-plane spin component correlations decay exponentially for all T but possibly with anomalies around both T/sub KT/ and T/sub S/.

6561 Superconductivity

REFER ALSO TO CITATION(S) 26371, 26457

27445 (CERN—83-03, pp 339-350) **Josephson technology.** Drangeid, K.E. (IBM Research Lab., Zurich (Switzerland)). 2 May 1983. NTIS (US Sales Only), PC A16/MF A01. (CONF-8208173—).

From CERN school of computing; Zinal, Switzerland (29 Aug 1982).

The author presents an introduction to Josephson junctions. After an introduction to the physical principles of superconductivity and the Josephson effect some applications are described with special regards to the implementation in digital circuits.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 27377

27446 **(CERN—83-09) Elementary course on general relativity.** Regge, T. (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Sep 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701394.

This report gives an informal account of the theory of general relativity, for non-specialists. It does not contain any detailed technical expose of tensor calculus but relies instead on a number of intuitive arguments. After a brief historical introduction the notion of curvature is developed, first in two dimensions (as done originally by Gauss) and then in higher dimensions, following the ideas of Riemann. This curvature is then related to quantities of physical interest through the following steps: i) The equality of gravitational and inertial masses is discussed and presented as the "weak equivalence principle". ii) This is then extended to the "strong equivalence principle" according to the original programme of Einstein. iii) The "strong equivalence principle" implies the existence of a local inertial observer in any point of space-time. In a sufficiently small region of space-time this observer will not sense any gravitational field. iv) In a larger region the observer will, however, sense residual tidal forces. These forces are identified with the curvature of spacetime, to achieve a direct geometrical interpretation of gravity. v) Finally certain curvature components are related to the distribution of matter through Einstein's field equations. Section 4 contains a discussion of the classical tests of the theory and of the possibility of detecting gravitational waves. Sections 5 and 6 deal with cosmology and with the possible extension of the theory along the lines of the original ideas of Einstein, with emphasis on the dimensional reduction techniques of current interest.

27447 **(ITEP—93(1982)) Instantons in supersymmetric theories.** Novikov, V.A.; Shifman, M.A.; Vajnshtejn, A.I.; Zakharov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1982. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701392.

Instanton effects are considered for a sample of supersymmetric theories: quantum mechanics, gluodynamics. Higgs model. The problem is how to reconcile the apparent lack of the boson-fermion symmetry in the effective instanton induced interaction with supersymmetry of the corresponding lagrangians. It is shown that in case of quantum mechanics and Higgs model there is no conflict between supersymmetry and the instanton calculus since the Ward identities, associated with the supersymmetry transformations, are satisfied. In case of supersymmetric gluodynamics the standard instanton calculus explicity violates the Ward identities. This is due to the lack of symmetry in the standard class of classical solutions used in the instanton calculus.

27448 **(JINR—E-2-83-384) Many-body problem in quantum mechanics and Hopf maps.** Polubarinov, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701378.

In the many-body problem in quantum mechanics, the transition from cartesian coordinates to inor variables is considered. Schroedinger and Heisenberg pictures are considered independently on each other. The Coulomb problem is reduced to the problem of four-dimensional oscillator. The transition to spinor variables is performed in two stages. At the first stage independent variables are introduced into the conventional Hamiltonian. At the second stage spinor variables are introduced as in the two-body problem: each three— dimensional Laplasian is replaced by four-dimensional Laplasian.

27449 **(JINR—E-4-83-50) New three-body equation.** Matveenko, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701381.

The Schroedinger equation is taken for the three-body problem in the molecular state approach. A new representation is built, which "kills" cross derivatives in the Schroedinger equation. This new equation has a simple form and "good" asymptotic properties. It may be interpreted as an equation for quasiparticles with masses depending on coordinates. Moreover, a potential energy term is modified and acquires the form of the three-particle interaction. This modification is of the kinematic nature.

27450 **(JINR—R-2-82-910) Connection between generators of three- and four dimensional turns with Hamilton's operators for particles with spins 1 and 1/2.** Yamaleev, R.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1982. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701384.

It is shown in the framework of the nonrelativistic theory that the structure of Hamilton operator for particles with spin 1 is strictly defined by the structure of group generator of three-dimensional turns; operator of spin, by infinitesimal operator of this groups. For particles with spin 1/2 similar connection is established with way transition from the 3-dimensional space to the Euclidean 4-dimensional space. Four-dimensional formalism allows one to construct such combinations of generator turns, which have commutational relations identical to those of orbital momentum, eiegevalues multiple to 1/2 infinitesimal operator-identical to the basis of Pauli matrix. The structure of such generator combinations corresponds to that one of Hamilton operator for Pauli equation. In 4-

dimensional space the symmetry is established between equations for particles with spins 1 and 1/2. The connection of transformational properties of the wave function of spin 1/2 particle with the group of 4-dimensional space turns is also considered.

27451 **(JINR—R-2-83-340) General relativity theory and spin.** Pestov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 3p. (In Russian). (CONF-8306179—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701387.

From Working meeting on problems of radiation and detection of gravitational waves; Dubna, USSR (7 Jun 1983).

Problem of spin introduction into the general relativity theory (G. R. T.) is put and solved. Equations, describing the interaction of the gravitational field and matter with spin are derived. G. R. T. equations for matter with spin are expressed by consistent G_4-invariant system of differential equations.

27452 **(JINR—R-2-83-352) "Collapse onto scattering centre" in quasipotential theory.** Gogokhiya, V.Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701388.

Quasipotential equation for the wave function in the impulse representation is investigated for the case of singular attractive potential U(r)=-lambda r^{-2}. It is shown that discrete energy spectrum in the nonrelativistic limit do not depend on an arbitrary constant and there appears no collapse onto scattering centre. These results are a consequence of self-adjointness of quasipotential operator in the impulse representation ("deficiency-index" n=0) in the comparison with Lippmann-Schwinger operator ("deficiency-index" n=1).

27453 **(JINR—R-4-83-222) New integrable classical system with two degrees of freedom.** Inozemtsev, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701389.

It is shown that a classical system with the Hamiltonian $H=(p_1^2+p_2^2)/2$ + lambda(qsub(1)qsub(2))sup(-2/3) possesses a constant of the motion $K=p_1p_2(p_1q_2-p_2q_1)$ + 2lambda(psub(2)qsub(2)-psub(1)qsub(1))(qsub(1)qsub(2))sup(-2/3); the quantum system with the same Hamiltonian has no other than H constants of the motion, polynomials in momenta being of order not higher than three.

27454 **(JINR—R-4-83-356) Integrable models of two interacting particles motion in an external field.** Inozemtsev, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701390.

Classical systems with a Hamiltonian $H=(p_1^2+p_2^2)/2+V_1(x_1)+V_2(x_2)+V_{12}(x_1-x_2)$ are considered. They correspond to the two-particle system on a streight line with an external field. The new sets of V_1, V_2, V_{12} potentials are found for which these systems are integrable.

27455 **(KFTI—83-18) Low-frequency asymptotics of Green functions for superfluid Bose-systems.** Kovalevskij, M.Yu.; Peletminskij, S.V.; Tarasov, A.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701391.

A method permitting to find low-frequency asymptotics of Green functions for superfluid Bose-liquid without using fictitious external sources is developed. The structure of general Green functions Gsub(ab)sup(+-)(k vector, ω) in the range of small ω and k vector and at vsub(n) vector - vsub(s) vector not equal to 0 is found. The structure of Green functions peculiarities due to the existence of the first and second sound depends considerably on commutativity of operators a vector and b vector, determining the Green function, with operator of the mass M. The method developed of the study of low-frequency asymptotics of Green functions of superfluid systems can be also applied when considering similar problems for other systems with spontaneously distorted symmetry.

27456 **(SAND—83-1522C) Propagation of acoustic waves in partially saturated porous media.** Wilson, R.K.; Walsh, E.K. (Sandia National Labs., Albuquerque, NM (USA); Florida Univ., Gainesville (USA)). 10 May 1984. Contract AC04-76DP00789. 14p. (CONF-840504—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010536.

From Southeastern conference on theoretical and applied mechanics; Pine Mountain, GA, USA (10 May 1984).

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The propagation of acoustic waves in a partially saturated porous medium is modeled analytically using the continuum theory of mixtures. Three dynamic equations are obtained for the velocities of the liquid, gas and solid phases. The coefficients contain an explicit dependence on the capillary pressure or surface tension. The resulting equations are discussed in the context of previously developed models.

27457 **Application of the WKB method to x-ray diffraction by one dimensional periodic structures.** Lee, P. (Los Alamos National Lab., NM). *Optics Communications;* **42**: No. 3, 195-198(1 Jul 1982).

The problem of X-ray diffraction by one dimensional periodic structures is solved by the WKB method. It is shown that this approach is equivalent to the usual thin film theory if the effect of multiple reflections may be ignored. The WKB method permits analytical solution for a large class of periodic structures, in particular, all Fourier representable profiles may now be solved.

27458 **Influence of closure on the behaviour of the Yvon-Born-Green equation for a system of hard rods.** Green, K.A. (Univ. of Tulsa, OK); Luks, K.D.; MacCarthy, J.E.; Kozak, J.J. *Molecular Physics;* **45**: No. 4, 897-913(1982).

The Yvon-Born-Green equation for a system of hard rods is solved using the Kirkwood superposition approximation and the results obtained are compared with those generated from the exact solution to the problem. Whereas the pair correlation function generated using the exact closure is unique over the entire range of densities, multiple solutions of the underlying integral equation appear above a certain density when the full Kirkwood superposition closure is used. The method of complementary variational principles is used to corroborate the findings in the pre-transition regime. The implications of these results are discussed in light of previously reported studies of the Yvon-Born-Green equation on systems of hard discs and hard spheres, where evidence of a fluid-solid transition was found.

27459 **Generalized Lagrangian and conservation law for the damped harmonic oscillator.** Bahar, L.Y.; Kwatny, H.G. (Drexel Univ., Philadelphia, PA). *American Journal of Physics;* **49**: No. 11, 74-77(Nov 1981). Contract AC01-76ET29112;ET-78-S-01-3088.

An explicit construction of the time-dependent Lagrangian for a damped harmonic oscillator is given. The connection between this Lagrangian with the time-independent one developed by Morse and Feshbach is established. Various methods of deriving a first integral for the equation of motion are given. It is shown that the results developed in this paper by direct means are in agreement with those obtained through the use of group-theoretic methods, such as invariance principles and Noether's theorem, which are mathematically more advanced approaches.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 27442

27460 **(UCRL—15584) Unconditionally stable element-by-element algorithms for dynamic problems.** Ortiz, M.; Pinsky, P.M.; Taylor, R.L. (California Univ., Berkeley (USA). Dept. of Civil Engineering). Jan 1982. Contract W-7405-ENG-48. 28p. (UCB/SESM—82/01). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011062.

A collection of results is presented regarding the consistency, stability and accuracy of operator split methods and product formula algorithms for general nonlinear equations of evolution.

These results are then applied to the structural dynamics problem, exploiting the element-by-element additive decomposition of the discrete dynamic equations resulting from a finite element discretization. Unconditionally stable algorithms are obtained that involve only element coefficient matrices. The storage requirements and operation counts are comparable to those of explicit methods. The method places no restriction on the topology of the finite element mesh.

27461 **Cubic spline method for solving second-order differential equations: theory and application to the Thomas-Fermi model for ions.** Raynor, S. (Harvard Univ., Cambridge, MA). *Chemical Physics (Amsterdam);* **66**: 409-415(1982). Contract AC02-79ER10470.

A cubic spline method is described which can be used to generate solutions to arbitrary second-order differential equations. The principle advantage is that this method provides accurate solutions which are cast in an analytic form, thus allowing the solutions to be applied to other problems. The method is applied to the solution of the Thomas-Fermi equation for singly and doubly ionized ions, and to the solution of the Schroedinger equation for the ground and first excited states of alkali metal atoms.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 27555, 27565, 27597

27462 **(DOE/ER/53126—T1) Theoretical studies of Elmo Bumpy Torus. Annual report.** (JAYCOR, San Diego, CA (USA)). Oct 1983. Contract AC01-82ER53126. 53p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010814.

The work was divided into six basic areas. Modeling studies compared neoclassical and Fokker-Planck analyses of the core plasma electrons with EBT-S data. Ion physics studies treated propagation and absorption of ion cyclotron waves along with investigation of the effect of wave absorption and instabilities on the ion distribution function. Parametric instability calculations identified processes and thresholds for nonlinear electron cyclotron resonance (ECR) wave absorption. Ring physics studies considered not only energetics and spatial effects, but also scaling and startup scenarios, along with the attendant microwave power requirements. Radio frequency (RF) control studies considered the possibility of influencing transport by wave absorption; related studies produced the important predictions of RF stabilization of interchange modes, without ponderomotive effects. Finally, microwave deposition studies considered the geometric aspects of propagation and absorption of microwaves in a real EBT cavity system.

27463 **(DOE/ET/51013—120) Linear theory of lower hybrid heating.** Bonoli, P. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 27 Mar 1984. Contract AC02-78ET51013. 63p. (PFC/RR—84-5). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010577.

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The linear theory of wave propagation in the lower hybrid range of frequencies is presented. The topics of accessibility, linear and quasi-linear theories of electron Landau damping, and the linear theory of ion Landau damping are covered. The theory of wave propagation is extended to include the effect of toroidal geometry. A simulation model incorporating these theories is described and numerical results obtained with the model are given.

27464 **(DOE/ET/53016—94) Solution adaptive triangular meshes with application to the simulation of plasma equilibrium.** Erlebacher, G. (Columbia Univ., New York (USA). School of Engineering and Applied Science). 1984. Contract AC02-76ET53016. 209p. (COO—2456/84). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010389.

Portions are illegible in microfiche products. Original copy available until stock is exhausted; Thesis.

A new discrete Laplace operator is constructed on a local mesh molecule, second order accurate on symmetric cell regions, based on local Taylor series expansions. This discrete Laplacian is then compared to the one commonly used in the literature. A truncation error analysis of gradient and Laplace operators calculated at triangle centroids reveals that the maximum bounds of their truncation errors are minimized on equilateral triangles, for a fixed triangle perimeter. A new adaptive strategy on arbitrary triangular grids is developed in which a uniform grid is defined with respect to the solution surface, as opposed to the x,y plane. Departures from mesh uniformity arises from a spacially dependent mean-curvature of the solution surface. The power of this new adaptive technique is applied to the problem of finding free-boundary plasma equilibria within the context of MHD. The geometry is toroidal, and axisymmetry in the toroidal direction is assumed. We are led to conclude that the grid should move, not towards regions of high curvature of magnetic flux, but rather towards regions of greater toroidal current density. This has a direct bearing on the accuracy with which the Grad-Shafranov equation is being approximated.

27465 **(GA-A—17386) Density variation due to wave heating in tokamak plasmas.** Hsu, J.Y.; Chan, V.S.; Harvey, R.W.; Hinton, F.L.; Prater, R.; Wong, S.K. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1984. Contract AT03-84ER53158. 6p. (CONF-840616—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009402.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

The tokamak plasma density has been observed to drop during ECRH, and to increase during ICRF and LHH. A mechanism is proposed here to explain these density variations. Depending on the nature of the specific wave heating, electrons or ions tend to pile up toward the weak field side. A poloidally varying electrostatic potential is expected to arise and to saturate at a level such as to balance the trapping effect due to the magnetic well and the rf heating. As a result, an E x B drift comparable to the ion vertical drift in a toroidal magnetic field may occur. Assuming that electrons move across the magnetic surfaces more freely due to the magnetic stochasticity or other turbulent diffusion mechanisms, and the particle confinement is primarily determined by the ion neoclassical transport rate, the ECRH can enhance the ion vertical drift and cause the density to drop, while the ICRF and LHH can reduce the ion vertical drift and improve the density confinement.

27466 **(GA-A—17483) 3-D MHD stability of high-beta free-boundary tokamak plasmas with finite edge-pressure-gradient and limiter stabilization.** Lee, J.K.; Bernard, L.C.; Chu, M.S.; Moore, R.W.; Ohyabu, N. (GA Technologies, Inc., San Diego, CA (USA)). Feb 1984. Contract AT03-84ER53158. 6p. (CONF-840616—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009188.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

Ideal and resistive external kink-tearing-ballooning modes are studied for high-beta toroidal tokamak plasmas with a varying pedestal and/or with stabilization due to a limiter. When the pedestal value is small, the mode spectrum peaks near $n=1$ with a monotonically decreasing growth rate in n, in which case the most unstable mode has a structure similar to an ideal external kink mode. As the pedestal value increases, the linear growth rate decreases for a fixed beta and the mode spectrum tends to broaden. The perturbation becomes localized near the plasma edge resembling the edge relaxation phenomenon in an H-mode tokamak discharge. The stabilizing effect of a limiter on high-beta MHD modes is considered for a finite-size toroidal limiter, a poloidal limiter, and a general limiter. For the latter two types of limiters, a 3-D linear stability analysis is necessary, coupling both poloidal and toroidal modes. The high-beta toroidal case has different characteristics from the zero-beta cyclindrical case; among them is a substantial reduction in growth rate even with modest contact area. Optimum position and size of a limiter are found through extensive parameter studies. A scheme to stabilize the high-beta external kink-tearing mode by means of a set of passive feedback coils is also discussed.

27467 (Juel—1862) Absolute measurement of radiation losses of a tokamak in the region of ultrasoft X-radiation. Petzold, H.C. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Duesseldorf Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Aug 1983. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751264.

In this work experiments were performed to investigate the question to which extent spectroscopic measurements in the ultrasoft X-ray region (lambda=1-10nm) are a useful technique for diagnosing the relatively cool edge region (Tsub(e)approx.=100-200 eV) of fusion-oriented plasmas. Object of these measurements was the plasma centre of a small tokamak where the plasma parameters are comparable to those in the edge region mentioned above. The measurements were done with a Bragg-spectrometer using either TAP (2d=2.59 nm) or lead stearate (2d=10.04 nm) as analyzer crystal. This allowed to cover the whole spectrum between 0.5 and 9 nm with one instrument. Using a photon-counting detector the spectrometer/detector system was absolutely calibrated by measuring the transmission of its different components by means of monochromatic X-ray radiation. For the investigated tokamak plasma intense line spectra in the region 1.4 nm <=lambda<=2.2 nm as well as at lambda>=4.4 nm have been observed, where the former was caused by the high ionization stages of oxygen (OVII and OVIII), whereas the latter could be explained by Ar- to Na-like ions of the metallic impurities Fe, Cr, and Ni.

27468 (Juel—1869) Hydrodynamic theory of convective transport across a dynamically stabilized diffuse boundary layer. Gerhauser, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Sep 1983. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751261.

The diffuse boundary layer between miscible liquids is subject to Rayleigh-Taylor instabilities if the heavy fluid is supported by the light one. The resulting rapid interchange of the liquids can be suppressed by enforcing vertical oscillations on the whole system. This dynamic stabilization is incomplete and produces some peculiar novel transport phenomena such as decay off the density profile into several steps, periodic peeling of density sheets of the boundary layer and the appearance of steady vortex flow. The theory presented in this paper identifies the basic mechanism as formation of convective cells leading to enhanced diffusion, and explains previous experimental results with water and ZnJ_2-solutions. A nonlinear treatment of the stationary convective flow problem gives the saturation amplitude of the ground mode and provides an upper bound for the maximum convective transport. The hydrodynamic model can be used for visualizing similar transport processes in the plasma of toroidal confinement devices such as sawtooth oscillations in soft disruptions of tokamak discharges and anomalous diffusion by excitation of convective cells. The latter process is investigated here in some detail, leading to the result that the maximum possible transport is of the order of Bohm diffusion.

27469 (KFTI—83-22) Excitation of gyrotropic plasma cylinder by a split antenna. Kurilko, P.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701404.

Analytical theory of spectrum of H-type, natural oscillations of open cylindric resonator filled with gyrotropic plasma with conducting shell and longitudinal slit of finite width is developed. In the general case of arbitrary parameters of the slit and plasma the task of spectrum and resonator field picture determination is reduced to the system solution on the basis of finite number of homogeneous algebraic equations for Fourier amplitudes of the field azimuthal harmonics.

27470 (LA-UR—84-620) Confinement time and energy balance in the CTX spheromak. Barnes, C.W.; Henins, I.; Hoida, H.W.; Jarboe, T.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840255—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007492.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

The multipoint Thomson scattering diagnostic on CTX allows measurement of electron plasma pressure. The pressure correlates well with the poloidal flux function. Analysis using equilibrium models allows the [β]/sub vol/ to be calculated from over 100 Thomson scattering profiles taken under standard conditions of spheromak operation where the plasma parameters vary widely within the discharge. The calculated tau/sub E/ increases with central core temperature and with density. The global magnetic energy decay time tau/sub B/2 is consistent with Spitzer-Harm resistivity, but with an anomaly factor of 2 to 4 which may decrease at small ratios of B/n. The n tau/sub E/ product reaches 4 x 10^9 s cm^{-3} during the hottest part of the discharge. A zero-dimensional energy balance code, which accurately includes all the major atomic physics processes and whose parameters have been constrained by comparision to experimental data, is used to identify the causes of energy loss that contribute to the observed confinement time. The most important power loss is that needed to replace the particles being lost and to maintain the constant density of the plateau.

27471 (LA-UR—84-621) Ohmic heating to 100-eV and helicity injection in CTX. Henins, I.; Barnes, C.W.; Hoida, H.W.; Jarboe, T.R.; Klingner, P.L.; Knox, S.O.; Platts, D.A.; Sherwood, A.R.; Wright, B.L. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840255—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007494.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

In the year since the last CT symposium, two major CTX results have been achieved. Electron temperatures over 100 eV have been obtained and the magnetic fields of the spheromaks have been sustained by helicity injection from the coaxial magnetized plasma source. The behavior and magnitude of the fields in the spheromak can be predicted from just the source voltage and flux by assuming a constant rate of helicity loss by resistive decay.

27472 (LA-UR—84-622) Space resolved absolutely calibrated VUV spectroscopic measurements on CTX. Hoida, H.W.; Barnes, C.W.; Henins, I.; Jarboe, T.R.; Sherwood, A.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840255—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007490.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

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Space resolved particle confinement times have been measured in two independent methods in CTX. The confinement time near the magnetic axis was found to be tau/sub p/ $\sim$ 100 μs and a factor of two lower for the outer flux surfaces. Attempts at sustainment so far have resulted in cold plasmas and additional impurities being injected with the flux. This problem is being specifically addressed in the electrode facility.

27473 (LA-UR—84-626) Mixed mode operation in CTX. Hoida, H.W.; Barnes, C.W.; Henins, I.; Jarboe, T.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-840255—12). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007493.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

Mixed method of operation with input powers of 10 MW to 20-MW results in hotter (ΔT/sub e/ $\sim$ 30 eV) longer lived spheromaks ($\sim$ 200 μs longer) than slow mode operation. However, a further increase in driving current is detrimental to the temperature of the spheromak (possibly due to the injection of impurities). In the mixed method, n = 2 oscillations no longer appear during the decay, apparently due to the sustainment of currents in the outer flux surfaces. This sustainment leads to more uniform j/B profiles, which may stabilize the n = 2.

27474 (LA-UR—84-748) Equilibrium and stability of the Los Alamos spheromak. Marklin, G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840255—18). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010064.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

The open mesh flux conserver (MFC) on the Los Alamos spheromak (CTX) has been equipped with a large number of Rogowski loops measuring the current in the individual segments of the MFC, providing a complete picture of the surface current pattern induced by the equilibrium and oscillations of the confined plasma. An analysis was made of the data from these Rogowski loops.

27475 (LA-UR—84-923) Two novel plasma diagnostics. Jahoda, F.C. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840616—8). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009970.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

A rapidly developing technology (single-mode optical fiber sensors) and recent fundamental research in non-linear optics (phase conjugation) both offer opportunities for novel plasma diagnostics.

27476 (LA-UR—84-942) Generalized Poisson brackets and nonlinear Liapunov stability: application to reduced MHD. Hazeltine, R.D.; Holm, D.D.; Marsden, J.E.; Morrison, P.J. (Los Alamos National Lab., NM (USA); Texas Univ., Austin (USA); California Univ., Berkeley (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840616—12). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009973.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

A method is presented for obtaining Liapunov functionals (LF) and proving nonlinear stability. The method uses the generalized Poisson bracket (GPB) formulation of Hamiltonian dynamics. As an illustration, certain stationary solutions of ideal reduced MHD (RMHD) are shown to be nonlinearly stable. This includes Grad-Shafranov and Alfven solutions.

27477 (LA-UR—84-1063) Plasma simulation studies of electron acceleration for beat wave and single frequency-laser heating schemes. Kindel, J.M.; Forslund, D.W.; Mori, W.B.; Joshi, C.; Dawson, J.M. (Los Alamos National Lab., NM (USA); California Univ., Los Angeles (USA)). 1984. Contract W-7405-ENG-26. 5p. (CONF-840616—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009988.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

Two-dimensional particle simulations with a finite laser beam show that beat wave acceleration can produce energetic electrons as seen in one-dimensional simulations.

27478 (LA-UR—84-1127) Lyapunov stability conditions for a relativistic multifluid plasma. Holm, D.D.; Kupershmidt, B.A. (Los Alamos National Lab., NM (USA); Tennessee Univ., Tullahoma (USA). Space Inst.). 1984. Contract W-7405-ENG-36. 9p. (CONF-840616—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010004.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

In preparation for establishing nonlinear stability conditions, the Hamiltonian structure is given for ideal relativistic multifluid plasma dynamics in the laboratory frame with the Hamiltonian functional equaling the relativistic energy minus the mass energy. The noncanonical Poisson bracket for this system turns out to be the same as for the nonrelativistic multifluid plasma, but with dynamical variables replaced by their relativistic counterparts. New constants of the motion are then derived from the Hamiltonian structure and used as Lyapunov functionals for proving sufficient conditions for nonlinear stability of relativistic multifluid plasma equilibria. The nonrelativistic limit of the formulation is uniformly regular, and nonlinear Lyapunov stability conditions derived earlier for a nonrelativistic multifluid plasma re-emerge in that limit.

27479 (PPPL—2029) Princeton spectral equilibrium code: PSEC. Ling, K.M.; Jardin, S.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1984. Contract AC02-76CH03073. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010770.

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A fast computer code has been developed to calculate free-boundary solutions to the plasma equilibrium equation that are consistent with the currents in external coils and conductors. The free-boundary formulation is based on the minimization of a mean-square error ϵ while the fixed-boundary solution is based on a variational principle and spectral representation of the coordinates x(psi,theta) and z(psi,theta). Specific calculations using the Columbia University Torus II, the Poloidal Divertor Experiment (PDX), and the Tokamak Fusion Test Reactor (TFTR) geometries are performed.

27480 (PPPL—2084) Formation of a 100-kA tokamak discharge in the Princeton large torus by lower hybrid waves. Jobes, F.; Stevens, J.; Bell, R.; Bernabei, S.; Cavallo, A.; Chu, T.K.; Cohen, S.; Denne, B.; Efthimion, P.; Hinnov, E. . (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1984. Contract AC02-76CH03073. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010748.

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The development of non-inductive current drive is of great importance in establishing the tokamak as a long-pulse or steady-state fusion reactor. Lower hybrid waves, carrying 200 kW of power at 800 MHz, have been launched into the PLT tokamak to initiate and drive the discharge current to a level in excess of 100 kA.

27481 (PPPL—2090) MHD stability properties of bean-shaped tokamaks. Grimm, R.C.; Chance, M.S.; Todd, A.M.M.; Manickam, J.; Okabayashi, M.; Tang, W.M.; Dewar, R.L.; Fishman, H.; Mendelsohn, S.L.; Monticello, D.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1984. Contract AC02-76CH03073. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010753.

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A study of the MHD stability properties of bean-shaped tokamak plasmas is presented. For ballooning modes, while increased indentation gives larger β stable configurations, the existence and accessibility of the second stable region is sensitive to the pressure and safety factor profiles. The second stable region appears at lower β values for large aspect ratio and moderately high q-values. Finite-Larmor-radius (FLR) kinetic effects can significantly improve the stability properties. For low q (< 1) operation, long wavelength (n $\sim$ 2,3) internal pressure driven modes occur at modest β/sub p/ values and accessibility to higher β operation is unlikely. Indentation modifies the nature of the usually vertical axisymmetric instability, but the mode can be passively stabilized by placing highly conducting plates near to the tips of the plasma bean. At constant q, indentation has a stabilizing effect on tearing modes.

27482 (PPPL—2096) Spectrometer sensitivity calibration in the extreme uv by means of branching ratios of magnetic dipole lines. Denne, B.; Hinnov, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1984. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010752.

Relative intensity measurements of various line pairs resulting from magnetic dipole transitions within the configurations s^2p^2 and s^2p^4, in conjunction with calculated transition probabilities, have been used to determine the wavelength dependence of the sensitivity of a grazing incidence spectrometer, in the range 400 to 1000 A. Emissions from Cr XIX, Fe XXI, Ni XXI and XXIII, Cu XXIV, and Zr XXVII ions in PLT tokamak discharges were used for this purpose. Absolute sensitivity of the spectrometer at selected wavelengths had been determined by the traditional hydrogen, helium, carbon, and oxygen electric-dipole line pairs from the same discharges. Similar attempts to use transitions in the s^2p^3 configura-

tions in Cr XVIII, Zr XXVI, and Mo XXVIII ions resulted in significant discrepancies that are ascribed to uncertainties in the corresponding calculated transition probabilities.

27483 **(PPPL—2098) Current driven instabilities of the kinetic shear Alfven wave: application to reversed field pinches and spheromaks.** Meyerhofer, D.D.; Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1984. Contract AC02-76CH03073. 46p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010769.

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The kinetic Alfven wave is studied in a cylindrical force-free plasma with self-consistent magnetic fields. This equilibrium represents a reversed field pinch or a spheromak. The stability of the wave is found to depend on the ratio of the electron drift velocity to the Alfven velocity. This ratio varies inversely with the square root of the plasma line density. The critical line density using the Spitzer-Harm electron distribution function is found for reversed field pinches with deuterium plasmas to be approximately 2×10^{18} m^{-1} and is 5×10^{17} m^{-1} in spheromaks with hydrogen plasmas. The critical line density is in reasonable agreement with experimental data for reversed field pinches.

27484 **(RL—83-038) Two-centre electronic wave functions in plasmas.** Rose, S.J. (Scientific and Technical Studies, London (UK)). Jun 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84700883.

The electronic structure occurring during collisions between ions in a plasma is considered in terms of two-centre wave-functions and exact solutions of the Schroedinger equation for the H_3^+ molecule are used to describe collisions between H atoms and H^+ ions in a hydrogen plasma. This 'transient chemistry' shows the existence of transitions not accounted for in the usual single-centre treatments and a coupling between radiation and ionic kinetic energy not previously described.

27485 **(SAI—84-3033/PRI-77) rf-induced stability and transport in axisymmetric tandem mirrors.** Myra, J.R.; D'Ippolito, D.A. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Apr 1984. Contract AC03-76ET53057. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010842.

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A kinetic theory of the ponderomotive force on a plasma due to an electromagnetic ion cyclotron wave is developed and applied to axisymmetric mirrors. The force due to nonresonant particles is shown to modify the usual MHD interchange stability criterion. Resonant particle contributions to the force arise from the absorption of photon momentum and spin. This effect drives a radial particle flux, modifies the radial ambipolar potential profile, and couples transport and stability.

27486 **(UCID—20025) Plasma potential control: initial results from tandem mirror experiment-upgrade.** Hopper, E.B. Jr. (Lawrence Livermore National Lab., CA (USA)). 28 Feb 1984. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010923.

Initial plasma potential control experiments used plates in the end fan, insulated from the end walls of TMX-U, which mapped along field lines to the plasma core (r/sub c/ $\leqq$ 12.9 cm). Measurements in which these plates are shorted to ground during plugging demonstrate that floating the plates increases the buildup rate of the central cell plasma, steepens the core density profile, and affects the plasma throughout the entire cross section. Floating the plates decreases the ion radial transport rate in the core by a factor of at least 1.5. Because of these encouraging results, in the next series of experiments more plates will be added, extending to a larger radius (r/sub c/ $\leqq$ 19.4 cm).

27487 **(UCRL—90425) Microstability theory for distributions separable in energy and pitch angle.** Smith, G.R. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1984. Contract W-7405-ENG-48. 5p. (CONF-840616—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009683.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

Distribution functions that are separable in energy and pitch angle allow analytical calculation of one or two velocity-space integrals that appear in the linear theory of certain microinstabilities.

27488 **(UCRL—90451) Microstability of TMX-U during initial thermal barrier operation.** Casper, T.A.; Berzins, L.V.; Ellis, R.F.; James, R.A.; Lasnier, C. (Lawrence Livermore National Lab., CA (USA); Maryland Univ., College Park (USA)). Mar 1984. Contract W-7405-ENG-48. 8p. (CONF-840616—10). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008944.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

During the initial thermal barrier experiments on the Tandem Mirror Experiment-Upgrade (TMX-U), we successfully demonstrated the principle of improved axial tandem mirror confinement achieved by establishment of both the thermal barrier and the ion confining potential peak. During this operation, we created both hot (100-keV) mirror-confined electron and hot (8-keV) mirror-confined ion populations in the end cells. In certain parameter ranges, we observed these species to be weakly unstable to various microinstabilities, but we did not observe clear evidence for an absolute limit to confinement.

27489 **Characteristics of ICRF heating near the second harmonic.** Chiu, S.C. (GA Technologies, Inc., San Diego, CA (USA)); Mau, T.K. (California Univ., Los Angeles (USA)). *Nuclear Fusion;* **23**: No. 12, 1613-1623(Dec 1983).

Analytical and numerical results of physical processes taking place around the second-harmonic resonance surface in ICRF heating are presented. It is shown that (1) symmetry of transmission coefficients follow from Onsager's reciprocity relation of the dielectric tensor, and (2) direct dissipation around the cyclotron harmonic layer is mostly due to the Bernstein branch and depends on ksub(parallel), becoming low for low ksub(parallel). The latter has the consequence that mode conversion and reflection are sensitively reduced by damping, but transmission is not.

27490 **Extension of Trubnikov's radiation loss formula to relativistic temperatures.** Tamor, S. (Science Applications, Inc., La Jolla, CA (USA)). *Nuclear Fusion;* **23**: No. 12, 1704-1708(Dec 1983).

Letter-to-the-editor.

A numerical study was carried out to find an extension of Trubnikov's formula for cyclotron radiation loss which is valid at relativistic temperatures. It is found that for temperatures up to 1000keV the loss can be fit by minor modification of the original result.

27491 **Scaling of edge-plasma turbulence in the Caltech tokamak.** Zweben, S.J.; Gould, R.W. (California Inst. of Tech., Pasadena (USA)). *Nuclear Fusion;* **23**: No. 12, 1625-1641(Dec 1983).

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Edge-plasma turbulence was investigated over a wide range of plasma and field parameters in the Caltech research tokamak. Fluctuation levels and spectra were measured using Langmuir probes in the region r/a=0.75-1.0. Under almost all conditions the edge plasma was turbulently unstable, with a broadband fluctuation spectrum in the drift-wave range of frequencies f=10-1000 kHz. A stable state was observed only in the very cold, low-current discharges formed at unusually high neutral filling pressure. Otherwise, the relative fluctuation level as monitored by the ion saturation current J^+ was very high, in the range J-tilde$^+$/J-bar$^+$ approx.=0.2-0.8, while the fluctuation power spectra were roughly invariant in shape. The relative fluctuation level was always highest near the wall and decreased monotonically toward the plasma centre. The same edge turbulence was observed with or without an outer limiter present. The relative fluctuation level was observed to be independent of the local collisionality over a range of nearly 100. The radial variation of J-tilde$^+$/J-bar$^+$ can be related to the radial density scale length Lsub(n) by J-tilde$^+$/J-bar$^+$ approx.=(3-5)rhosub(s)/Lsub(n).

27492 Plasma rotation in the PDX tokamak. Brau, K.; Bitter, M.; Goldston, R.J.; Manos, D.; McGuire, K.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **23**: No. 12, 1643-1655(Dec 1983).

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Toroidal and poloidal rotation has been measured in the Poloidal Divertor Experiment (PDX) tokamak in Ohmic and neutral-beam heated plasmas in a variety of discharge conditions and in both circular and diverted configurations. Rotation velocities were deduced from Doppler shifts of magnetic dipole (M1) lines and lines of optically allowed transitions in the visible and UV regions, from Ksub(α) emission, and also from an array of magnetic pickup loops. Poloidal and toroidal rotation velocities in Ohmically heated discharges were usually less than $3x10^5 cm.s^{-1}$. Near the plasma edge, the toroidal rotation velocity varies with poloidal angle both before and during neutral-beam injection. No systematic poloidal rotation was observed during neutral-beam injection centred about or displaced 10 cm from the horizontal midplane, which implies that the poloidal damping time tausub(theta)<0.5tausub(ii) consistent with theoretical estimates. The central toroidal rotation velocity during neutral-beam injection scales linearly with the quantity Psub(abs)$\sqrt{}$nsub(e) and is independent of plasma current and toroidal magnet field. The toroidal rotation velocity is higher in deuterium than in hydrogen plasmas, and also in diverted discharges as compared with circular ones. Toroidal rotation decay times after injection range from 80-100 ms at the centre to 160-180 ms at half the minor radius. Modelling of the radial profile of toroidal rotation indicates a central momentum diffusivity of the order of $8x10^3 cm^2.s^{-1}$. This is approximately a factor of three higher than the momentum diffusivity obtained from the decay time. All present theories are inadequate in accounting for the observed damping rate of vsub(phi).

27493 Experimental evidence for outward radial transport of impurities from the central cell of TMX. Strand, O.T.; Moos, H.W. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Physics); Allen, S.L. (Lawrence Livermore National Lab., CA (USA)). *Nuclear Fusion;* **23**: No. 12, 1675-1681(Dec 1983).

Letter-to-the-editor.

Impurity sources and confinement times in the central cell of TMX were examined by studying the extreme ultraviolet (EUV) emissions from intrinsic and injected impurities. Impurity ions from gases puffed radially toward the central-cell plasma showed very little radial penetration into the plasma. The confinement times of highly ionized intrinsic and injected impurities in the central cell were of the order of or less than the deuterium ion confinement times; the ambient density ratios of O V to O VI indicate overall O VI confinement times near the axis of 0.3 to 3 ms. Impurities introduced into the central-cell plasma were not detected in either end-cell plasma, indicating that axial losses of impurities from the central cell were small. This result agrees with theoretical calculations of the axial confinement times and suggests that most of the losses were radial. The radial flux of impurity ions determined from the measured radial profiles of the ambient impurity ion densities is primarily outward; the magnitude of these fluxes also implies a short confinement time for impurity ions.

27494 Measurement of radiation loss rate of an iron-seeded plasma. Zhu, Z.Y.; Wang, J.S.; Iglesias, E.J.; Maffei, K.C.; Griem, H.R. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). *Nuclear Fusion;* **23**: No. 12, 1686-1689(Dec 1983).

Letter-to-the-editor.

The radiation loss rate for iron ions has been determined at Tsub(e)=45eV in a theta-pinch plasma. The intensities of almost all strong vacuum-ultraviolet lines of Fe VII-XI ions were measured, and the total radiative power was obtained from the observed line intensities. The iron impurity concentration was derived from the absolute intensity of the Fe X forbidden line. The experimental radiation loss rate is compared with calculations.

27495 Proposed scenario for burn control in tokamak reactor. Sestero, A. (Associazione EURATOM-ENEA sulla Fusione Centro Ricerche Energia Frascati, C.P. 65, 00044 Frascati, Rome). *Nuclear Technology;* **4**: No. 3, 437-451(Nov 1983).

A feedback control scenario of plasma burning in a tokamak reactor is investigated, whereby compression-expansion of the plasma provides routine control against small deviations from equilibrium, while occasional larger perturbations (expected to be of the cooling type only) are counteracted by the switching on of part of the additional heating system. The feasibility of the proposal is investigated on a profile-corrected zero-dimensional linearized model of the burning plasma, involving separate energy balances for electrons, ions, and alpha particles. Special attention is paid to control-theory features, with the aim to suitably interface them with plasma physics and fusion physics. A positive assessment concerning the feasibility of the proposed scheme is derived, with the proviso, however, that enough accuracy be obtained from the diagnostics that control the input to the feedback loop.

27496 A nuclear diagnostic for fast alpha particles. Grisham, L.R.; Dawson, J.M.; Post, D.E. (Princeton University Plasma Physics Laboratory Princeton, New Jersey 08544). *Nuclear Technology;* **4**: No. 3, 452-455(Nov 1983). Contract AC02-76CH03073.

The authors investigate the possibility of seeding a fusion plasma with nuclei that can undergo nuclear reactions with energetic alpha particles to produce product nuclei that are radioactive. If a fraction of these product nuclei can be collected and measured, one can obtain information about the presence of fast alpha particles. It appears that a feasible diagnostic could be based on the $^{10}B(\alpha,n)^{13}N$ reaction.

27497 Dose rates from induced activity in the ELMO Bumpy Torus proof-of-principle device. Alsmiller, R.G.; Barish, J.; Barnes, J.M.; Santoro, R.T. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Nuclear Technology;* **4**: No. 3, 491-497(Nov 1983). Contract W-7405-ENG-26.

Calculated results of the dose rates from induced activity in the enclosure of the ELMO Bumpy Torus proof-of-principle device (EBT-P) are presented. A cylindrical model of EBT-P is used. EBT-P will have a hydrogen plasma and thus the plasma will not produce neutrons, but substantial numbers of photoneutrons will be produced and it is the induced activity from these photoneutrons that is considered. The activation dose rates are presented for a variety of operating times and times after shutdown. Dose rates about 5 to 10 mrem/h at 1 h after shutdown are obtained and the major contributor to the dose rate at 1 h after shutdown is found to be ^{24}Na (half-life=15.0 h).

27498 Electron transport in one-dimensional plasmas. Wienke, B.R. (Los Alamos National Laboratory Computing Division, Los Alamos, New Mexico 87545). *Nuclear Technology;* **4**: No. 3, 426-436(Nov 1983).

A one-dimensional, multigroup, discrete ordinates technique for computing electron energy deposition in plasmas is detailed. The Fokker-Planck collision operator is employed in the continuous approximation and electric fields (considered external) are included in the equation. Bremsstrahlung processes are not treated. Comparisons with analytic and Monte Carlo results are given. Fits to deposition profiles and energy scaling are proposed and discussed for monoenergetic and Maxwellian sources in the range, 0 to 150 keV, with and without uniform fields. The techniques employed to track electrons are generally useful in situations where the background plasma temperature is an order of magnitude smaller than the electron energy and collective plasma effects are negligible. We have used the approach successfully in laser pellet implosion applications.

27499 Soliton experiments in plasmas. Lonngren, K.E. (Iowa Univ., Iowa City (USA). Dept. of Electrical and Computer Engineering). *Plasma Physics;* **25**: No. 9, 943-982(Sep 1983).

The experiments on solitons in plasmas performed during the period 1970 to 1982 are reviewed. Suggestions for future experiments are presented.

27500 **Plasma transport in stochastic magnetic fields. Pt. 3. Kinetics of test particle diffusion.** Krommes, J.A.; Oberman, C.; Kleva, R.G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Plasma Physics;* **30**: 11-56(Aug 1983).

A discussion is given of test particle transport in the presence of specified stochastic magnetic fields, with particular emphasis on the collisional limit. Certain paradoxes and inconsistencies in the literature regarding the form of the scaling laws are resolved by carefully distinguishing a number of physically distinct correlation lengths, and thus identifying several collisional subregimes. The common procedure of averaging the conventional fluid equations over the statistics of a random field is shown to fail in some important cases because of breakdown of the Chapman-Enskog ordering in the presence of a stochastic field component with short autocorrelation length. A modified perturbation theory is introduced which leads to a Kubo-like formula valid in all collisional regimes. The direct-interaction approximation is shown to fail in the interesting limit in which the orbit exponentiation length Lsub(K) appears explicitly. A higher-order renormalized kinetic theory in which Lsub(K) appears naturally is discussed and used to rederive more systematically the results of the heuristic scaling arguments.

27501 **Linear model for the tearing mode of a tokamak plasma with flow and a resistive wall boundary condition.** Jensen, T.H.; Chu, M.S. (GA Technologies, Inc., San Diego, CA (USA)). *Journal of Plasma Physics;* **30**: 57-63(Aug 1983).

The tearing mode of a tokamak plasma without flow may be stabilized by the presence of a conducting wall surrounding the plasma. When the wall has a finite resistivity, its presence does not affect stability, only growth rates. If, however the plasma has a flow relative to the resistive wall, both stability and growth rates may be affected. For the cylindrical, circular cross-section tokamak the problem is formulated as a complex eigenvalue problem, with a complex eigen-value Δ', which in the limit of vanishing flow becomes identical to the usual 'delta prime'. The real part of Δ' describes as usual the power absorbed at the singular surface while the imaginary part describes absorption of momentum. It is found that for a plasma with shearless flow, a resistive wall has a stabilizing effect which even for relatively small flow velocities approaches that of a wall of infinite conductivity. Shear flow is found inherently destabilizing, but important only for very large flow velocities.

27502 **Linear density drift instabilities in very low beta plasmas: a different approach.** Gary, S.P. (Los Alamos National Lab., NM (USA)). *Journal of Plasma Physics;* **30**: 75-94(Aug 1983).

A study of the linear Vlasov electromagnetic dispersion equation for density drift instabilities in very low β plasmas is reported. A uniform magnetic field and a weak uniform density gradient are assumed.

27503 **Steady state compact toroidal plasma production.** Turner, W.C. (to Dept. of Energy). US Patent Application 6-495,386. 17 May 1983. 21p. Contract W-7405-ENG-48.

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This invention relates to the confinement of field reversed plasma rings and, more particularly, to the steady state maintainance of field reversed plasma rings produced by coaxial plasma guns.

27504 **Monte Carlo treatment for neutral particle transport problems in a toroidal plasma.** Inoue, S.; Nakahara, Y.; Suzuki, T.; Taji, Y. (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken). *Nuclear Science and Engineering;* **73**: No. 2, 119-124(Feb 1980).

Transport of neutral particles in a toroidal plasma is treated in the same manner as that of neutrons by the Monte Carlo method. A new sampling technique of flight-path length is proposed for the torus geometry. Several routines relating to the toroidal geometry have been developed and incorporated into the neutron and gamma-ray transport Monte Carlo code "MORSE." Results obtained from sample calculations to check the cylindrical approximation show that hot neutrals escape more easily from the torus than from the cylinder, while cold neutrals are retained better in the cylinder. Furthermore, the spectrum of the leakage neutrals is compared with the neutral and ion spectra inside the torus.

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REFER ALSO TO CITATION(S) 25482, 25482, 25600, 25882, 25975, 26132, 26170, 26286, 26287, 26288, 26289, 26290, 26291, 26292, 26293, 26294, 26296, 26297, 26298, 26299, 26300, 26301, 26302, 26303, 26304, 26305, 26306, 26307, 26308, 26309, 26311, 26316, 26339, 26340, 26350, 26774, 27493

27505 (ANL—83-55, pp 113-120) **Magnetic fusion energy research.** Jul 1983. NTIS, PC A10/MF A01.

In Chemical Technology Division. Annual technical report, 1982.

The main design effort focused on the evaluation of critical issues that affect tritium control, tritium recovery, and blanket design for fusion reactors. This effort was divided between two major design studies - FED/INTOR and STARFIRE/DEMO. The former was an international study to establish a world-wide consensus on tokamak fusion-reactor design; the latter focused on blanket design. The design studies, which were completed in 1982, included an assessment of both a representative solid-oxide (Li_2O) and liquid-metal (17Li83Pb) blanket. Other design efforts included investigation of some of the waste management problems associated with disposal of first-wall/blanket modules. In addition, CMT participated in a study sponsored by the Electric Power Research Institute, entitled Technical Risk Assessment of the Tritium Fuel Cycle. The main CMT effort was to define the tritium systems needed in a fusion reactor plant.

27506 **(BNL—34548) Overview of MRB fusion.** Maschke, A.W. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 5p. (CONF-840142—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010288.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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The Momentum-Rich Beam (MRB) fusion concept is a new method of achieving thermonuclear ignition in a single shell DT target. The advantage of the system is that only 1/4 to 1/2 MJ is needed for ignition, and the acceleration system for producing the beams may be 80% efficient or better. This combination of circumstances means that the driver costs for a full-scale ignition system are an order of magnitude less expensive than a comparable laser or heavy ion driver. This is especially important when one realizes that the cost of a conventional 5 MJ driver is in the 1-2 G$ range. This same problem has arisen for magnetic confinement fusion, where the cost of the next step, a full-scale reactor, is prohibitive. The program at BNL is divided into two parts. One part is a program to investigate the physics of interaction between the MRB's and the pellet. This is done with the LASNEX hydro code at LANL. The purpose of this report is to determine the minimum requirements the MRB's must have in order to achieve ignition.

27507 **(CONF-811113—59-Draft) Advanced limiters for ISX.** Mioduszewski, P.K.; Edmonds, P.H.; Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 9p. NTIS, PC A02; 3; GPO Dep. Order Number DE84004584.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

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Continuous removal of heat and particles becomes a vital necessity in future steady state fusion devices. The pump limiter seems to be an attractive concept to combine these two tasks. On ISX various schemes of pump limiters are being explored with the final goal to furnish the ISX-C device with a pump limiter to handle heat removal and particle control in steady state. The emphasis of the present paper is on pump limiters based on ballistic

particle collection. If this concept turns out to be successful in supplying sufficient pumping efficiency, it may be possible to design pump limiters without a leading edge. Analytical calculations of the particle collection efficiency are given for various limiter configurations. Pumping efficiencies of approximately +-10%, depending on the specific configuration, seem to be feasible which should be sufficient for steady state operation. First experimental results on pump limiter studies in ISX-B confirm the calculated collection efficiencies. By measuring the ion saturation current to the limiter blade and the pressure build-up simultaneously, a correlation between the incident particle flux and the pressure rise which agrees well with a simple model was found.

27508 **(CONF-840614—20) Tritium inventories and associated tritium breeding requirement for fusion power reactors.** Jung, J. (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006404.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

This paper presents an assessment of tritium-breeding requirement for fusion power reactors. The analysis is based on an evaluation of time-dependent tritium inventories in the reactor system. The method presented can be applied to any fusion systems in operation on a steady-state mode as well as on a pulsed mode. The effect of reactor-parameter changes on the required tritium breeding ratio is analyzed for a variety of reactor operation scenarios.

27509 **(CONF-840614—23) Overview of the blanket comparison and selection study.** Smith, D.L.; Baker, C.C.; Sze, D.K.; Abdou, M.A.; Gordon, J.D.; Morgan, G.D.; Piet, S.; Wong, C.P. (Argonne National Lab., IL (USA); California Univ., Los Angeles (USA); TRW, Inc., Redondo Beach, CA (USA); McDonnell Douglas Astronautics Co., St. Louis, MO (USA); EG and G Idaho, Inc., Idaho Falls (USA); GA Technologies, Inc., San Diego, CA (USA)). Jan 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84006408.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

A comprehensive Blanket Comparison and Selection Study was conducted to evaluate proposed D-T fusion reactor blanket concepts and to identify those concepts that offer the greatest potential for fusion reactor applications. The multilaboratory study was led by Argonne National Laboratory and included support from thirteen industrial, national and university laboratories; six primary subcontractors and seven specialized contributors. The primary objectives of the program were (1) to identify a small number ($\sim$ 3) of the blanket concepts that should be the focus of the blanket R and D program, (2) to define and prioritize the critical issues for the leading blanket concepts, and (3) to provide technical input for development of blanket R and D programs. A blanket concept is generally defined by the selection of the component materials, viz., breeder, coolant, structure, and neutron multiplier, and specification of the geometrical configuration. Blanket concepts were evaluated for both the tokamak and tandem mirror reactor configurations using the STARFIRE and MARS reactor designs as a basis, with appropriate modifications to reflect recent advances in technology.

27510 **(CONF-840614—24) Blankets for tritium catalyzed deuterium (TCD) fusion reactors.** Jung, J.; Greenspan, E.; Miley, G.H. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA). Fusion Studies Lab.). Jan 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006443.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The TCD fusion fuel cycle - where the ^{3}He from the D(D,n)^{3}He reaction is transmuted, by neutron capture in the blanket, into tritium which is fed back to the plasma - was recently recognized as being potentially more promising than the Catalyzed Deuterium (Cat-D) fuel cycle for tokamak power reactors. It is the purpose of the present work to assess the feasibility of, and to identify promising directions for designing blankets for TCD fusion reactors.

27511 **(CONF-840614—26) Assessment of problems associated with tritium containment.** Sze, D.K.; Hassanein, A.; Piet, S.; Wong, C.; Bjorndahl, W. (Argonne National Lab., IL (USA); EG and G Idaho, Inc., Idaho Falls (USA); GA Technologies, Inc., San Diego, CA (USA); TRW, Inc., Redondo Beach, CA (USA)). Jan 1984. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006441.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Preventing tritium leakage across a large heat transfer area at high temperature is one of the most difficult problems associated with a D-T fusion reactor design. One of the most efficient methods to reduce the mobility of tritium is to convert it to tritiated water. Most solid breeder systems use a purge gas and assume tritium will be oxidized into the water form. For 17 Li-83Pb system, a double-walled steam generator is used. Tritium is assumed to be oxidized across the gap in between the two walls. However, if tritium cannot be oxidized efficiently, the tritium containment problem can become critical.

27512 **(CONF-840614—32) Nuclear analysis of liquid metal blanket designs.** Gohar, Y. (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006742.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

This study concludes the following results: (a) the lithium-lead blanket achieves a higher tritium breeding ratio with a smaller blanket thickness relative to the lithium blanket, (b) the lithium blanket generates more energy per fusion neutron relative to the lithium-lead, (c) the lithium-6 enrichment is required for the lithium-lead blanket to reduce the blanket thickness, and (d) the energy deposition per fusion neutron reaches a saturation as the blanket thickness, the steel fraction in the reflector, or the reflector zone thickness increases. This allows one to design the blanket for a specific TBR without reducing the energy production.

27513 **(CONF-840614—34) Implication of TRIO-01 heat transfer results on solid breeder blanket designs.** Misra, B.; Clemmer, R.G.; Finn, P.A. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006743.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The greatest uncertainty in recent solid breeder blanket designs is associated with the thermophysical properties of lithium ceramics. The thermal conductivity of a solid breeder (κ) and its dependence on nuclear irradiation can be a major design-limiting factor. The TRIO-01 experiment studied in-situ recovery of tritium from a miniature solid breeder blanket (γ-$LiAlO_2$, 65% dense). The data of the TRIO-01 experiment provide an indirect measurement of κ of γ-$LiAlO_2$. This paper briefly discusses calculation of κ from TRIO-01 data and its implications on STARFIRE-type blanket designs.

27514 **(CONF-840614—39) Liquid metal breeder-coolant blanket concept.** Sze, D.K.; Cha, Y.S.; Gohar, Y.; Majumdar, S.; Picologlou, P.; Smith, D.L. (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006554.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

This paper discusses the results and conclusions of a self-cooled, liquid-metal design for a D-T fusion reactor, which is part of the Blanket Comparison and Selection Study (BCSS). The effort reported in this paper emphasizes the inboard blanket of a tokamak since the problem is most severe in this region. The work on a self-cooled TMR is also reported.

27515 **(CONF-840616—11) Experiments and theory on half-harmonic light and two-plasmon decay.** Berger, R.L.; Busch, G.; Johnson, R.R.; Powers, L.V.; Schroeder, R.J.; Shepard, C.L.; Tarvin, J.A. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1984. Contract AC08-82DP40152. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008945.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

Experimental data and theoretical calculations of half-integer harmonic light emission from laser-heated plasmas is presented. The data is quantitatively interpreted by use of the theoretical models.

27516 **(DOE/DP/40124—14) Laboratory for laser energetics. Annual report, 1 October 1980-30 September 1981.** (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1981. Contract AC08-80DP40124. 183p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84010415.

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During 1981 we have carried out research and development programs in the following areas: (1) X-Ray Biophysics. The high x-ray conversion efficiency of laser-produced plasmas allows subnanosecond probing of crystal-like structures using x-ray diffraction. (2) X-Ray Laser. Laser-produced plasmas are prime candidates for an x-ray laser medium. Population inversion which could result in gain in the 100-A region has been measured in collisionally pumped transitions of various materials. (3). Picosecond Research. This area developed from the high-speed diagnostics and switching requirements of the laser-fusion research. (4) Microfabrication. The need to develop precise microscopic objects (laser-fusion targets) for the fusion program at LLE has stimulated inventions having broader application than just in the field of laser fusion. (5) Optical Materials. A strong program in optical materials development and characterization has been developed at LLE. We now have the capability to design, fabricate, and fully test and characterize a wide variety of optical coatings. We are carrying out development work on laser applications of liquid crystals and on uv transmissive optical materials.

27517 **(DOE/DP/40124—16) Inertial fusion program and National Laser Users Facility projects. Annual report, October 1, 1981-September 30, 1982.** (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1982. Contract AC08-80DP40124. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84010417.

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The Laboratory for Laser Energetics (LLE) continues to pursue its three-fold mission of (a) demonstrating the feasibility of laser fusion with short-wavelength lasers and directly driven targets, (b) operating the National Laser Users Facility (NLUF), and (c) developing advanced technology areas related to high-energy-density phenomena.

27518 **(DOE/DP/40124—40) Characterization of micron-sized, optical coating defects by photothermal deflection microscopy.** Abate, J.A.; Schmid, A.W.; Guardalben, M.G.; Smith, D.J.; Jacobs, S.D. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Apr 1984. Contract AC08-80DP40124. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011150.

Lab Report 154.

Information about the localized absorbing defects in optical thin films is required for a better understanding of laser-induced damage. Photothermal deflection microscopy offers a nondestructive optical diagnostic which can yield spatially resolved absorption data on simple and multiple-layer AR and HR dielectric coatings. This paper describes the computer-controlled apparatus used to generate absorption maps of dielectric thin films and an experiment in which a partial correlation between localized absorption sites and damage caused by nanosecond laser irradiation at 351 nm is established. An absolute calibration of absorption for our measurement technique is presented here. Micron-sized absorbtive defects of Cu were introduced into our coatings to provide a means of calibration. Also presented here are some preliminary data on the modification of the absorption signatures measured by photo-thermal deflection as a function of the location of the defect within the coating layers.

27519 **(DOE/DP/40137—2) Study of stimulated Brillouin and Raman scattering. Final report, 1982-1983.** Pietrzyk, Z.A.; Brooks, R.D.; Berger, R. (Washington Univ., Seattle (USA). Dept. of Nuclear Engineering). 1983. Contract AS08-81DP40137. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011260.

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Investigations of SRS and hot electron production as observed in the laboratory are discussed along with some computer modeling of these processes. Since the plasma was preformed with n everywhere less than 1/4 n/sub c/, a situation generally much different from laser produced plasmas, it was possible to observe hot electrons generated exclusively by the SRS process, a situation rare among SRS experiments. Using 10.6 μm radiation from a pulsed CO_2 laser, suprathermal electron distributions have been directly detected which have Maxwellian shapes and corresponding temperatures from 29 to 105 keV. A temporal correlation between the fast electron pulses and the back-scattered SRS radiation was also seen.

27520 **(DOE/ER—0045/11) Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.** (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract W-7405-ENG-26. 230p. NTIS, PC A11/MF A01; GPO Dep. Order Number DE84007335.

Separate abstracts were prepared for 29 of the included sections. (MOW)

27521 (DOE/ER—0045/11, pp 4-10) **Control of activation levels to simplify waste management of fusion reactor ferritic steel components.** Wiffen, F.W.; Santoro, R.T. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The objective of this work is to examine the restrictions placed on the composition of steels to allow simplified waste management after service in a fusion reactor first wall. Decay of steel activity within tens of years could simplify waste disposal or even permit recycle. For material recycle, N, Al, Ni, Cu, Nb, and Mo must be excluded. For shallow land burial, initial concentration limits include (in at. ppM) Ni, <20,000; Mo, <3650; N, <3650; Cu, <2400; and Nb, <1.0. Other constituents of steels will not be limited.

27522 (DOE/ER—0045/11, pp 11-20) **Alloy development for fast induced radioactivity decay for fusion reactor applications.** Klueh, R.L.; Bloom, E.E. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

During the operation of a fusion reactor, the structural material of the first wall and blanket structure will become highly radioactive from activation by the high-energy fusion neutrons. A difficult radioactive waste management problem will be involved in the disposal of this material after the service lifetime is complete. One way to minimize the management problem is the use of structural materials where the radioactive isotopes in the irradiated material decay to levels that allow for simplified disposal techniques. We are exploring how ferritic and austenitic steels could be developed to meet this objective.

27523 (DOE/ER—0045/11, pp 21-28) **Magnetic forces on a ferromagnetic HT-9 first wall/blanket and coolant pipe.** Lechtenberg, T.A.; Dahms, C.; Attaya, H. (GA Technologies, Inc., San Diego, CA; Univ. of Wisconsin, Madison). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

The GFUN 3D code was used to model the toroidal fields and determine the magnetic body forces on the STARFIRE design for coolant pipes exiting the first wall sector and first wall/blanket modules. The HT-9 coolant pipes were modeled on the basis of a square bar having the same length and material volume as the coolant pipes. The stress analysis was performed using these magnetic forces applied to a pipe of 4 meters length, 8.25 cm O.D., and 0.75

cm thickness by the MODSAP stress analysis code. For the first wall/blanket module, GFUN 3D does not allow full modeling of the complex thin-walled structure or numerous small tubes because of the element aspect ratio limitations. Therefore, to obtain three dimensional loads, a solid homogeneous equivalent structure was used.

27524 (DOE/ER—0045/11, pp 30-37) **Neutron source characterization for materials experiments.** Greenwood, L.R. (Argonne National Lab., IL). Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

Damage and gas production calculations are summarized for the CTR 31, 32, 34, and 35 irradiations in HFIR. Neutron dosimetry measurements and damage calculations are also presented for the T2 and RB1 irradiations in HFIR. The helium production from nickel has been revised according to new cross section evaluations for ^{59}Ni. The status of all other experiments is summarized.

27525 (DOE/ER—0045/11, pp 43-51) **Disk-bend ductility tests for irradiated materials.** Klueh, R.L.; Braski, D.N. Mar 1984. NTIS, PC A11/MF A01.

In Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1983.

We modified the HEDL disk-bend test machine and are using it to qualitatively screen alloys that are susceptible to embrittlement caused by irradiation. Tests designed to understand the disk-bend test in relation to a uniaxial test are discussed. Selected results of tests of neutron-irradiated material are also presented.

27526 (DOE/ET/52021—T1) **High field compact tokamak reactor (HFCTR) conceptual design. Final report.** (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jan 1979. Contract AC02-77ET52021. 480p. NTIS MF A01; 2; GPO Dep. Order Number DE84008865.

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A conceptual design has been developed for a compact (R_0 = 6.0 m) high field (B/sub T/ = 7.4 T) tokamak demonstration power reactor which can produce fusion power densities as high as 10 MW/m^3 with a spatially averaged value of toroidal beta of less than 5%. The HFCTR design is based upon minimal extrapolation from experimentally established plasma confinement and MHD stability in tokamak devices. A unique design for the Nb_3Sn toroidal-field magnet system reduces the stress in the high-field trunk region and allows the achievement of high fields with a small radial build. An integrated system of automated actuators, vacuum and current-carrying mechanical joints and flexible cryostats allow total modularization of the reactor, including the coil systems. A detailed estimate of maintenance operation time indicated the possibility of very high plant availability. The modest value of toroidal beta permits a simple plasma-shaping coil system, located inside the TF coil trunk. Heating of the central plasma is attained by the use of ripple-assisted injection of 120-keV D^0 beams, which is also used for dynamic control of the plasma temperature during the burn period. A FLIBE-lithium blanket is designed especially for high-power-density operation in a high-field environment, and gives an overall tritium breeding ratio of 1.05.

27527 (DOE/ET/52028—1) **Fusion reactor technology studies. Final report for period August 1, 1972 - October 31, 1978.** Kulcinski, G.L.; Maynard, C.W. (Wisconsin Univ., Madison (USA)). Apr 1984. Contract AC02-76ET52028. 43p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011389.

Major accomplishments for the period August 1, 1972 - October 31, 1978 include the publishing of four comprehensive fusion reactor conceptual design studies; experimental studies in the areas of radiation damage, plasma-wall interactions, superconducting magnets and 14-MeV neutron cross sections; development of the concepts of carbon curtains and ISSEC's for use in fusion reactors; development of a neutron and gamma heating computer code, a radioactivity and afterheat computer code and a neutral transport computer code; and studies in the areas of RF heating for tokamaks and resource assessment for fusion reactors.

27528 (DOE/ET/53088—135) **Nonlinear dynamics of magnetic islands with curvature and pressure.** Kotschenreuther, M.; Hazeltine, R.D.; Morrison, P.J. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Mar 1984. Contract FG05-80ET53088. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010968.

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Curvature and finite pressure are known to have a dramatic influence on linear magnetic tearing stability. An analytic theory of the nonlinear resistive growth of magnetic islands in tokamaks is presented here, including the interchange driving term. A Grad-Shafranov equation to describe the MHD equilibrium of thin islands is derived. The resistive evolution of these islands is then obtained. Interchange effects are found to become progressively less important with increasing island width.

27529 (EIR—455) **Cross section sensitivity and uncertainty analysis for European INTOR and U.S. FED designs.** Pelloni, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jun 1982. 85p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84700884.

Also published as General Atomic Report GA-A--16685.

The European Community International Tokamak Reactor (INTOR-EC) and U.S. Fusion Engineering Device (FED) were used as a basis to investigate the uncertainties of several neutronics performance parameters such as tritium breeding ratio in the blanket, atomic displacement rate in the copper stabilizer, and nuclear heating in the epoxy-based insulator that arise due to nuclear data uncertainties and data processing discrepancies. Neutronics calculations were performed and reaction rates estimated for the recent INTOR-EC using the DLC-37 and DLC-41 cross section libraries. In general, the basic cross section data are known accurately enough to determine the tritium breeding ratio of the INTOR-EC within +-2%. The atomic displacement rate and nuclear heating rate in the superconducting magnet of FED (and presumably also INTOR-EC), however, can be predicted to only about +-12% to 24%. If additional accuracy is required, improved measurements of the iron, chromium, and nickel cross sections in the energy range between 12 and 14 MeV will be needed.

27530 (GA-A—17275) **Doublet III ECH Project administration plan.** Prater, R. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1983. Contract AT03-76ET51011. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008592.

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This administrative plan establishes the framework, organization, and methods for integrating a number of diverse system requirements. Essential to the integration process is the establishment of concise communication between program participants. Single point contacts have been designated at GA, DOE/OFE, and DOE/SAN so that all official correspondence is routed through one individual at each management control point. The names of the individuals are given.

27531 (GA-A—17471) **Components and transmission systems for ECH.** Moeller, C.P.; Prater, R.; Lin, S.H. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1984. Contract AT03-84ER51044. 13p. (CONF-840311—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011314.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

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We describe the elements of a transmission and launching system used to transmit 200 kW of 60 GHz power per gyrotron in the 2 MW ECH experiment on the Doublet III tokamak. Various system components such as mode converters, waveguide bends, and directional couplers, as well as system efficiency and operation, are discussed.

27532 **(IAE—3526/7) Matching parameters of a plasma shell and power supply electric circuit in a linear Z pinch device.** Zemskov, A.I.; Matveev, V.V.; Prut, V.V.; Udalov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701403.

Conditions of self-consistency of a discharge chamber and power supply electric circuit are analyzed for obtaining the neutron yield $>= 10^{13}$ n/pulse in a noncylindrical z-pinch device at the expense of increasing the capacitor energy and discharge current. Optimum dimensionless parameters are presented; the neutron yield dependence on the current is derived. An experimental installation is described - a short z-pinch device, where plasma shell in the discharge chamber is formed as a result of plasma injection from an electrothermal injector. Current oscillograms with a sharply expressed particularity are obtained, during which a hard X-radiation burst has been observed. Measurements of X-radiation spatial-, time- and energy characteristics have been carried out. A high reproducibility of the results is noted.

27533 (JAERI-M—9999, pp 239-246) **Past and present of fusion reactor neutronics integral experiments.** Seki, Yasushi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1982. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. (NEANDC(J)—81/U; INDC(JAP)—68/L; CONF-8111184—).

From Seminar on nuclear data; Tokai, Ibaraki, Japan (26 Nov 1981).

Past history and present status of integral experiments on D-T fusion reactor neutronics are reviewed. In addition, the requests from the fusion reactor design to the integral experiments are summarized.

27534 (JAERI-M—9999, pp 247-256) **First blanket experiment by FNS.** Maekawa, Hiroshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1982. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. (NEANDC(J)—81/U; INDC(JAP)—68/L; CONF-8111184—).

From Seminar on nuclear data; Tokai, Ibaraki, Japan (26 Nov 1981).

As the first blanket experiment using the Fusion Neutronics Source (FNS), the integral experiment on a Li_2O-C assembly was carried out. Measured items were as follows: 1) absolute fission-rate distributions, 2) tritium production-rate distributions, 3) response distributions of LiF TLD's, 4) induced activity of SUS316 stainless steel. The measured values were compared with calculated ones.

27535 **(KFTI—83-8) Possibility of the control by the relation of plasma radii and the first wall in thermonuclear devices.** Kotenko, V.G.; Romanov, S.S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701405.

The possibility for controlling the distance between plasma filament and the wall in some magnetic systems of the stellator type is considered. The analysis is carried out according to the known literary data for linear configurations with point conductors in the range of alteration of parameter rsub(c)asup(-1) < 0.5 where rsub(c) the position of the separatris nib, a is the radius of the cylinder on which conductors are placed. The analysis has shown that in the range of alteration of the rsub(c)asup(-1) parameters the control of the position of separatrix rib most effectively realizes in three-turn classic stellarator.

27536 **(KMSF-U—1445) Holographic interferometry using twenty-picosecond uv pulses to obtain time resolved hydro measurements of selenium and gold plasmas.** Busch, G.E.; Johnson, R.R.; Shepard, C.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1984. Contract AC08-82DP40152. 5p. (CONF-8406104—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009485.

From Topical meeting on ultrafast phenomena; Monterey, CA, USA (12 Jun 1984).

A plasma probing (263 nm) pulse, from a temporally compressed YLF oscillator, delineates electron densities of very early (10 to 150 psec) selenium and gold plasmas using holographic interferometry.

27537 **(LA—9990-PR) Tokamak poloidal field systems. Progress report, January 1-December 31, 1983.** Rogers, J.D. (comp.). (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011006.

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The work performed in support of the TFCX or DCT-8 studies is reported in detail and covers most aspects of the poloidal field (PF) design that were considered. The work, of a conceptual engineering design nature, included determination of magnetics, forces and fields; superconductor design and losses; structural channel support of internally cooled cable superconductor (ICCS); fault conditions for shorted PF coils; heat transfer, fluid dynamics, stability, and transient pressure rise for 3.0 and 4.5 K ICCS PF coils; and overall design of both pool bath cooled conductor (PBCC) and ICCS PF coil sets. Eddy current calculations in tokamak structures were made for transient conditions with a number of general and particular conclusions reached. Impovements to the 2 MJ switch test facility were made to increase its current carrying capacity substantially.

27538 **(LA—10035-MS) Some considerations on silicone oil in high-current and energy-disconnecting mechanisms.** Vogel, H.F. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011021.

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Silicone oil is considered inflammable. The dissociation products generated by an electric arc under silicone oil are known to form a highly explosive mixture with air. We calculate the arc energy required for dissociation to be 32 kJ per liter of gas mixture at standard pressure and temperature. We calculate the arc voltage gradient at a pressure of 50 atm and current density of 1 kA/mm^2 to be 0.5 kV/cm, resulting in an arc voltage of several kV, depending on the arc length. In a multikiloampere arc, the resulting arc power is likely to cause a pressure of many atmospheres in a shock wave.

27539 **(LA—10048-MS) Hamiltonian structure of field-line equations.** Channell, P.J. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011019.

The canonical structure of the field-line equations in toroidal geometry is derived, and the global Hamiltonian for one choice of canonical coordinates is given explicitly.

27540 **(LA-UR—84-168) FIRST STEP towards ICF commercialization.** Saylor, W.W.; Pendergrass, J.H.; Dudziak, D.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840614—15). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006017.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Production of tritium for weapons and fusion R and D programs and successful development of Inertial Confinement Fusion (ICF) technologies are important national goals. A conceptual design for an ICF facility to meet these goals is presented. FIRST STEP (Fusion, Inertial, Reduced-Requirements Systems Test for Special Nuclear Material, Tritium, and Energy Production) is a concept for a plant to produce SNM, tritium, and energy while serving as a test bed for ICF technology development. A credible conceptual design for an ICF SNM and tritium production facility that competes favorably with fission technology on the bases of cost, production quality, and safety was sought. FIRST STEP is also designed to be an engineering test facility that integrates systems required for an ICF power plant and that is intermediate in scale between proof-of-principle experiment and commercial power plant. FIRST STEP driver and pellet performance requirements are moderate and represent reasonable intermediate goals in an R and D plan for ICF commercialization. Repetition rate require-

ments for FIRST STEP are similar to those of commercial size plants and FIRST STEP can be used to integrate systems under realistic ICF conditions.

27541 **(LA-UR—84-169) FIRST STEP blanket structure and fuel assembly design.** Saylor, W.W.; Pendergrass, J.H.; Thayer, G.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840614—14). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006018.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

FIRST STEP (Fusion, Inertial, Reduced Requirement Systems Test for Special Nuclear Material, Tritium, and Energy Production) is an Inertial Confinement Fusion (ICF) plant designed to produce tritium, SNM, and energy using near-term technology. It is an integrated facility that will serve as a test bed for fusion power plant technology. The design of the blanket structure and blanket fuel assembly for wetted-wall FIRST STEP reactors is presented here.

27542 **(LA-UR—84-170) Use of the Streaming Matrix Hybrid Method for discrete-ordinates fusion reactor calculations.** Battat, M.E.; Davidson, J.W.; Dudziak, D.J.; Thayer, G.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840614—18). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006019.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The use of the discrete-ordinates method for solving two-dimensional, neutral-particle transport in fusion reactor blankets and shields is often limited by inherent inaccuracies due to the ray-effect. This effect presents a particular problem in the case of neutron streaming in the large internal void regions of a fusion reactor. A deterministic streaming technique called the Streaming Matrix Hybrid Method (SMHM) has been incorporated in the two-dimensional discrete-ordinates code TRIDENT-CTR. Calculations have been performed for an actual inertial-confinement fusion (ICF) reactor design using TRIDENT-CTR both with and without the SMHM. Comparisons of the calculated fluxes indicate that substantial mitigation of the ray effect can be achieved with the SMHM. Calculations were performed for the Los Alamos FIRST STEP hybrid ICF reactor designed for tritium production. Conventional ^{238}U fuel rod assemblies surround the spherical steel target chamber to form an annular cylindrical blanket. An axial fuel region is included to complete the blanket.

27543 **(LA-UR—84-623) Analysis of surface currents on the CTX mesh flux conserver.** Wright, B.L. (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 5p. (CONF-840255—14). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007491.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

The use of discharge cleaning and a mesh structure for the flux conserver have led to hotter, less resistive, spheromak configurations in the CTX experiment. Achievement of these conditions has been accompanied by the appearance of oscillations - most notably seen on magnetic probe signals - that were previously not present. These oscillations are observed both during the sustainment (V/sub gun/ not equal to 0) and the decaying (V/sub gun/ = 0) phases of the discharge and are attributed to the presence of internal kink modes driven by the departure of the plasma current distribution from the Taylor state: j/B = const. Computations suggest that an n-1 mode becomes unstable when j/B increases away from the magnetic axis (sustained spheromak) whereas an n=2 mode becomes unstable for radially decreasing j/B (decaying spheromak). The results reported are from an 80-cm-diameter mesh flux conserver constructed form 0.5"-diameter copper stock. It is of the same oblate rooftop design as used for previous work with a dimension of 40 cm from front to back.

27544 **(LA-UR—84-624) Sustained spheromak technology.** Platts, D.A.; Sherwood, A.R.; Jarboe, T.R.; Linford, R.K.; Hoida, H.W.; Henins, I. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-840255—13). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007497.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

The goal of these experiments is to devise a technique for driving a spheromak using dc-powered electrodes. The reduction or elimination of pulsed power components in the spheromak source would result in more attractive reactors, and simpler, cheaper experiments. This is important as experiments get larger and approach reactor size. According to some concepts, the dc spheromak would operate with plasma injection so that it would clean up any impurities produced during its formation. These features make the investigation of dc-powered spheromaks interesting. The questions that need to be answered in this investigation are: (1) can a spheromak be sustained by a dc source; and (2) can a practical source be designed to produce a hot clean plasma. After summarizing the evidence which suggests an answer to question one, the approach being taken to answer question two is discussed.

27545 **(LA-UR—84-870) Internal magnetic field measurements in a translating field-reversed configuration.** Armstrong, W.T.; Chrien, R.E.; McKenna, K.F.; Rej, D.J.; Sherwood, E.G.; Siemon, R.E.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). 23 Feb 1984. Contract W-7405-ENG-36. 5p. (CONF-840255—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010054.

From 6. US-Japan symposium on compact toroid research; Princeton, NJ, USA (20 Feb 1984).

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Magnetic field probes have been employed to study the internal field structure of Field-Reversed Configurations (FRCs) translating past the probes in the FRX-C/T device. Internal closed flux surfaces can be studied in this manner with minimal perturbation because of the rapid transit of the plasma (translational velocity v/sub z/ $\sim$ 10 cm/μs). Data have been taken using a low-field (5 kG), 5-mtorr-D_2 gas-puff mode of operation in the FRC source coil which yields an initial plasma density of $\sim 1 \times 10^{15}$ cm^{-3} and x/sub s/ $\sim$ 0.04. FRCs translate from the $\sim$ 25 cm radius source coil into a 20 cm radius metal translation vessel. Two translation conditions are studied: (1) translation into a 4 kG guide field (matched guide-field case), resulting in similar plasma parameters but with x/sub s/ $\sim$ .45, and (2) translation into a 1 kG guide field (reduced guide-field case), resulting in expansion of the FRC to conditions of density $\sim 3 \times 10^{14}$, external field $B_0 \sim 2$ kG and x/sub s/ $\sim$ 0.7. The expected reversed B/sub z/ structure is observed in both cases. However, the field measurements indicate a possible sideways offset of the FRC from the machine axis in the matched case. There is also evidence of island structure in the reduced guide-field case. Fluctuating levels of B/sub theta/ are ovserved with amplitudes $\leq B_0/3$ in both cases. Field measurements on the FRC symmetry axis in the reduced guide-field case indicate β on the separatrix of β/ sub s/ $\simeq$ 0.3 (indexed to the external field) has been achieved. This decrease of β/sub s/ with increased x/sub s/ is expected, and desirable for improved plasma confinement.

27546 **(LA-UR—84-1062) Scaling of electron range reduction by magnetic insulation.** Lee, K. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840616—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009989.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

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The range of energetic electrons in subnormal density material can be dramatically reduced to prevent target preheat without significant mass penalty. Electron range scaling law and calculational design of an experiment to verify range reduction are presented.

27547 **(LBL—16528) Influence of processing on the cryogenic mechanical properties of high strength high manganese stainless steel.** Ogawa, R.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Aug 1983. Contract AC03-76SF00098. 10p. (CONF-830841—31). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008242.

From Cryogenic engineering conference and international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

New high strength structural steels have been required for the large superconducting magnets that will be used for the next step test facility for fusion reactor research. The new materials must have high yield strength accompanied with better toughness and better fatigue resistance compared with the conventional nitrogen-strengthened stainless steels such as AISI 304LN and 316LN that were used for the cases of the toroidal field coils for the Large Coil Project. A number of new high manganese austenitic steels have been proposed for new cryogenic structural alloys since they can offer low cost, stable austenite and high strength.

27548 **(LBL—17256) High current heavy ion beam transport experiment at LBL.** Chupp, W.; Faltens, A.; Hartwig, E.C.; Keefe, D.; Kim, C.H.; Pike, C.; Rosenblum, S.S.; Tiefenback, M.; Vanecek, D.; Warwick, A.I. (Lawrence Berkeley Lab., CA (USA)). Jan 1984. Contract AC03-76SF00098. 13p. (CONF-840142—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009225.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

Information on the current limit in a long quadrupole transport channel is required in designing an accelerator driver for an inertial confinement fusion system. Although a current transport limit was proposed by Maschke, quantitative estimates require a detailed knowledge of the stability of the beam. Analytic calculations based on the Kapchinskij-Vladimirskij (K-V) distribution function have identified transversely unstable modes, but particle simulations have shown that some of the K-V instabilities are benign, i.e., particles redistribute themselves in the 4-D transverse phase space, but the rms emittances do not grow. Some preliminary results of beam transport experiments were reported in the 1983 Particle Accelerator Conference in Santa Fe.

27549 **(MTR—7921-Summ.) Summary report of findings and recommendations. Workshop panel on commercializing inertial confinement fusion.** Greeley, R.S.; Ghovanlou, A.; Ettlinger, L.; Lord, N. (Mitre Corp., McLean, VA (USA)). 1978. Contract AC01-78DP40040. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008892.

The panel felt that commercialization of inertial confinement fusion will eventually require the involvement of a broad range of industrial and user participants. The panel felt that it is not at all too soon to encourage involvement of these participants directly in the program and, with their assistance, to develop a program plan to provide for increasing participation of industry as the ICF program milestones are achieved.

27550 **(NIIEFA-P-B—0554) Plane-toroidal solenoid near ferromagnets.** Mingalov, B.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1981. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701406.

An analytical method is suggested to calculate the characteristics of a magnetic system consisting of several identical planar coils of an arbitrary form located axisymmetrically around a ferromagnetic body limited by cylindrical surfaces. A particular case of such system is realized as a constituent of the toroidal magnetic system of a tokamak type installation. As an example of calculating the system characteristics analytical formulas are obtained for the corrugation of a magnetic field in case of axisymmetrical system.

27551 **(NRL-MR—5204) Observation of Rayleigh-Taylor-like structures in a laser-accelerated foil.** Whitlock, R.R.; Emery, M.H.; Stamper, J.A.; McLean, E.A.; Obenschain, S.P.; Peckerar, M.C. (Naval Research Lab., Washington, DC (USA)). 19 Mar 1984. Contract AI08-79DP40092. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010847.

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Laser-accelerated targets have been predicted to be subject to the Rayleigh-Taylor hydrodynamic instability. The development of the instability was studied by introducing mass thickness variations in foil targets and observing the development of the target nonuniformities by side-on flash x radiography. Observations were made of target structures and mass redistribution effects which resemble Rayleigh-Taylor bubbles and spikes, including not only advanced broadening of the spike tips on the laser-irradiated side of the foil but also projections of mass on the unirradiated side. The observations compare well with numerical simulations.

27552 **(ORNL/TM—9002) Plasma engineering studies for Tennessee Tokamak (TENTOK) fusion power reactor.** Yokoyama, K.E.; Lacatski, J.T.; Miller, J.B.; Bryan, W.E.; King, P.W.; Santoro, R.T.; Uckan, N.A.; Shannon, T.E. (Oak Ridge National Lab., TN (USA)). Feb 1984. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007555.

This paper summarizes the results of the plasma engineering and systems analysis studies for the Tennessee Tokamak (TENTOK) fusion power reactor. TENTOK is a 3000-MW(t) central station power plant that uses deuterium-tritium fuel in a D-shaped tokamak plasma configuration with a double-null poloidal divertor. The major parameters are R_0 = 6.4 m, a = 1.6 m, σ (elongation) = 1.65, [n] = 1.5 x 10^{20} m^{-3}, [T] = 15 keV, [β] = 6%, B/sub T/ (on-axis) = 5.6 T, I/sub p/ = 8.5 MA, and wall loading = 3 MW/m^2. Detailed analyses are performed in the areas of (1) transport simulation using the one-and-one-half-dimensional (1-1/2-D) WHIST transport code, (2) equilibrium/poloidal field coil systems, (3) neutral beam and radiofrequency (rf) heating, and (4) pellet fueling. In addition, impurity control systems, diagnostics and controls, and possible microwave plasma preheating and steady-state current drive options are also considered. Some of the major features of TENTOK include rf heating in the ion cyclotron range of frequencies, superconducting equilibrium field coils outside the superconducting toroidal field coils, a double-null poloidal divertor for impurity control and alpha ash removal, and rf-assisted plasma preheating and current startup.

27553 **(PPPL—2048) Initial conditioning of the TFTR vacuum vessel.** Dylla, H.F.; Blanchard, W.R.; Krawchuk, R.B.; Hawryluk, R.J.; Owens, D.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1984. Contract AC02-76CH03073. 21p. (CONF-831011—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006281.

From American Vacuum Society symposium; Boston, MA, USA (31 Oct 1983).

We report on the initial conditioning of the Tokamak Fusion Test Reactor (TFTR) vacuum vessel prior to the initiation of first plasma discharges, and during subsequent operation with high power ohmically-heated plasmas. Following evacuation of the 86 m^3 vessel with the 10^4 l/s high vacuum pumping system, the vessel was conditioned by a 15 A dc glow discharge in H_2 at a pressure of 5 mTorr. Rapid-pulse discharge cleaning was used subsequently to preferentially condition the graphite plasma limiters. The effectiveness of the discharge cleaning was monitored by measuring the exhaust rates of the primary discharge products (CO/C_2H_4, CH_4, and H_2O). After 175 hours of glow discharge treatment, the equivalent of 50 monolayers of C and O was removed from the vessel, and the partial pressures of impurity gases were reduced to the range of 10^{-9}-10^{-10} Torr.

27554 **(PPPL—2094) Magnetic field line Hamiltonian.** Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1984. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010403.

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The magnetic field line Hamiltonian and the associated canonical form for the magnetic field are important concepts both for understanding toroidal plasma physics and for practical calculations. A number of important properties of the canonical or Hamiltonian representation are derived and their importance is explained.

27555 **(PPPL—2104) Effect of finite β on stellarator transport.** Mynick, H.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1984. Contract AC02-76CH03073. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011199.

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A theory of the modification of stellarator transport due to the presence of finite plasma pressure is developed, and applied to a range of stellarator configurations. For many configurations of interest, plasma transport can change by more than an order of magnitude in the progression from zero pressure to the equilibrium β limit of the device. Thus, a stellarator with transport-optimized vacuum fields can have poor confinement at the desired operating β. Without an external compensating field, increasing β tends to degrade confinement, unless the initial field structure is very carefully chosen. The theory permits one to correctly determine this vacuum structure, in terms of the desired structure of the field at a prescribed operating β. With a compensating external field, the deleterious effect of finite β on transport can be partially eliminated.

27556 **(PPPL—2105) Environmental monitoring report for calendar year 1983.** Stencel, J.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1984. Contract AC02-76CH03073. 59p. NTIS, PC A04; 3; GPO Dep. Order Number DE84010771.

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The results of the environmental monitoring program for CY83 for the Princeton Plasma Physics Laboratory (PPPL) are presented and discussed. Besides the Princeton Large Torus (PLT) and Poloidal Divertor Experiment (PDX), PPPL's largest tokamak, the Tokamak Fusion Test Reactor (TFTR) had a full year of operation. A phased approach has been planned to assure the proper level of monitoring to coincide with the TFTR program. During CY83 there were no adverse effects to the environment resulting from any operational program at PPPL and the Laboratory was in compliance with all applicable Federal, State, and local environmental regulations.

27557 (RL—83-069, pp vp) **Chemical compatibility between lithium compounds and transition metals.** Pulham, R.J.; Watson, W.R. (Nottingham Univ. (UK). Dept. of Chemistry). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

The aim is to investigate the chemical reactions or otherwise of lithium compounds; Li_7Pb_2 (a tritium breeder), Li_2O (breeder and impurity), Li_3N and LiH (impurities) with containment and fusion reactor component metals - 316 and austenitic steels, titanium. Experimental details are given and results are summarized.

27558 (RL—83-069, pp vp) **Theoretical studies of fusion materials.** De Leeuw, S.W.; Dixon, M.; Elliott, R.J. (Oxford Univ. (UK). Dept. of Theoretical Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. (CONF-8209215—).

From Meeting of SERC research grant holders in fusion technology; Abingdon, UK (28 Sep 1982).

The main aim of the work is the study of metals containing a high concentration of defects generated in a displacement cascade. Molecular dynamics simulation techniques are used. Two basic difficulties arise when one tries to implement simulation techniques for these materials. These are: (1) the choice of a suitable potential model; and (2) the choice of boundary conditions for the simulations. Work using copper as the chosen material is reported briefly.

27559 **(SAND—83-1248C) Prospective light ion ICF driver.** Buttram, M.; Quintenz, J.P.; Johnson, D.J. (Sandia National Labs., Albuquerque, NM (USA)). 1983. Contract AC04-76DP00789. 9p. (CONF-831203—137). NTIS, PC A02; 3; GPO Dep. Order Number DE84003763.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

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An 11 TW pulsed power module designed to be an ion beam driver is described. Approximately 18 of these modules would be required for a reactor. It employs four gas spark gap switched submodules with 3 stages of saturable inductor (magnetic switch) pulse compression to drive a common voltage amplifier, accelerator section. The spark gaps and magnetic switches operate at 3 MV.

27560 **(SAND—84-0127) Improved performance of TiC-coated graphite limiters by surface texturing.** Whitley, J.B.; Mattox, D.M. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011168.

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TiC-coated graphite limiters are currently in wide use as tokamak limiters. These limiters usually suffer a groove type of damage caused by plasma disruptions. A surface texturing treatment is described that reduces the occurrence of this type of damage.

27561 **(UCID—20050) Octupole anchor for tandem mirrors.** Hopper, E.B. Jr. (Lawrence Livermore National Lab., CA (USA)). 21 Mar 1984. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010650.

The octupole anchor is a very promising alternative to the usual quadrupole designs. The most critical unsolved problem is stabilization of the trapped particle mode. The anchor magnetic field is low because MHD stabilization is by hot electrons, thus permitting relatively small magnet currents and conductor cross sections. Increasing the field to a sufficient level to permit operation of the thermal barrier and electrostatic plug required for trapped particle mode stabilization would require much more massive magnets, higher ECRH power, and the much more complex operating scenario associated with standard quadrupole operation. Despite these complications, the absence of a long transition (with an axial minimum in B) between the central cell and the octupole makes the option attractive.

27562 **(UCRL—15593) Design of GA thermochemical water-splitting process for the Mirror Advanced Reactor System.** Brown, L.C. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1983. Contract W-7405-ENG-48. 62p. (GA-A—17106). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011058.

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GA interfaced the sulfur-iodine thermochemical water-splitting cycle to the Mirror Advanced Reactor System (MARS). The results of this effort follow as one section and part of a second section to be included in the MARS final report. This section describes the process and its interface to the reactor. The capital and operating costs for the hydrogen plant are described.

27563 **(UCRL—89292) Tritium breeding and activation in the cascade reactor.** Blink, J.A. (Lawrence Livermore National Lab., CA (USA)). 5 Dec 1983. Contract W-7405-ENG-48. 20p. (CONF-831203—117). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008347.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Cascade is an inertial fusion reactor that uses circulating Li_2O pellets as a coolant and tritium breeding medium. The pellets flow through a horizontal rotating vessel, and they are held against the vessel wall by centrifugal force. Three wall designs were considered: a steel shell and a SiC shell prestressed by Al or steel cables. The nuclear heating, tritium breeding ration, afterheat, inhalation biological hazard potential, and shallow land burial index were calculated for each configuration. Tritium breeding is more than adequate (1.35). Spray cooling of the wall exterior will be required during operation, but thermal radiation heat removal will be sufficient after shutdown. Allowable release fractions during an accident are higher than in comparable designs. Disposal of activated components by shallow land burial is feasible. Hands-on maintenance of the SiC/Al wall will be possible if it is moved away from the reflector.

27564 **(UCRL—89966-Rev.1) Normal zone detectors for a large number of inductively coupled coils. Revision 1.** Owen, E.W.; Shimer, D.W. (Lawrence Livermore National Lab., CA (USA)). 3 Nov 1983. Contract W-7405-ENG-48. 32p. (CONF-831203—138-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011053.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

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In order to protect a set of inductively coupled superconducting magnets, it is necessary to locate and measure normal zone voltages that are small compared with the mutual and self-induced voltages. The method described in this paper uses two sets of voltage measurements to locate and measure one or more normal zones in any number of coupled coils. One set of voltages is the outputs of bridges that balance out the self-induced voltages. The other set of voltages can be the voltages across the coils, although alternatives are possible. The two sets of equations form a single combined set of equations. Each normal zone location or combination of normal zones has a set of these combined equations associated with it. It is demonstrated that the normal zone can be located and the correct set chosen, allowing determination of the size of the normal zone. Only a few operations take place in a working detector: multiplication of a constant, addition, and simple decision-making. In many cases the detector for each coil, although weakly linked to the other detectors, can be considered to be independent. The effect on accuracy of changes in the system parameters is discussed.

27565 **(UCRL—90089) Photoemissive materials for 0.35μm laser fiducials in x-ray streak cameras.** Hale, C.P.; Medecki, H.; Lee, P.H.Y. (Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 18p. (CONF-840387—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008348.

From 2. topical meeting on laser techniques in the extreme ultraviolet; Boulder, CO, USA (5 Mar 1984).

Using a soft x-ray streak camera, materials are tested for suitability as transmission photocathodes when irradiated by 0.35μm laser pulses. Preliminary measurements of sensitivity, dynamic range and temporal resolution are reported. A practical fiber optic fiducial under development for laser fusion x-ray diagnostics on the LLNL Nova laser system is described.

27566 **(UCRL—90240) Developing models for simulation of pinched-beam dynamics in heavy ion fusion.** Boyd, J.K.; Mark, J.W.K.; Sharp, W.M.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA); Stanford Linear Accelerator Center, CA (USA)). 18 Jan 1984. Contract W-7405-ENG-48. 11p. (CONF-840142—9). NTIS, PC A02; 3; GPO Dep. Order Number DE84011054.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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Hydrodynamic models have been derived by Mark and Yu and by others to describe energetic pinched-beams, such as those used in ion-beam fusion. The closure of the Mark-Yu model is obtained with adiabatic assumptions mathematically analogous to those of Chew, Goldberger, and Low for MHD. The other models treated here use an ideal gas closure and a closure by Newcomb based on an expansion in V/sub th//V/sub z/. Features of these hydrodynamic beam models are compared with a kinetic treatment.

27567 **(UCRL—90240-Rev.1) Developing models for simulation of pinched-beam dynamics in heavy ion fusion. Revision 1.** Boyd, J.K.; Mark, J.W.K.; Sharp, W.M.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA); Stanford Linear Accelerator Center, CA (USA)). 22 Feb 1984. Contract W-7405-ENG-48. 12p. (CONF-840142—9-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011057.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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For heavy-ion fusion energy applications, Mark and Yu have derived hydrodynamic models for numerical simulation of energetic pinched-beams including self-pinches and external-current pinches. These pinched-beams are applicable to beam propagation in fusion chambers and to the US High Temperature Experiment. The closure of the Mark-Yu model is obtained with adiabatic assumptions mathematically analogous to those of Chew, Goldberger, and Low for MHD. Features of this hydrodynamic beam model are compared with a kinetic treatment.

27568 **(UCRL—90241) Recent Livermore estimates on the energy gain of cryogenic single-shell ion beam targets.** Lindl, J.D.; Mark, J.W.K. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 9p. (CONF-840142—10). NTIS, PC A02; 3; GPO Dep. Order Number DE84011052.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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Our recent estimates are that the energy-gain for cryogenic single-shell targets are close to those of similar double-shelled targets. However, the peak-power requirements for single-shell targets are still about a factor of two higher.

27569 **(UCRL—90330) Linear pinch driven by a moving compact torus.** Hartman, C.W.; Hammer, J.H.; Eddleman, J.L. (Lawrence Livermore National Lab., CA (USA)). 25 Apr 1984. Contract W-7405-ENG-48. 9p. (CONF-8403100—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011317.

From Conference of Z-pinches for fusion; Alexandria, VA, USA (29 Mar 1984).

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In principle, a Z-pinch of sufficiently large aspect ratio can provide arbitrarily high magnetic field intensity for the confinement of plasma. In practice, however, achievable field intensities and timescales are limited by parasitic inductances, pulse driver power, current, voltage, and voltage standoff of nearby insulating surfaces or surrounding gas. Further, instabilities may dominate to prevent high fields (kink mode) or enhance them (sausage mode) but in a nonuniform and uncontrollable way. In this paper we discuss an approach to producing a high-field-intensity pinch using a moving compact torus. The moving torus can serve as a very high power driver and may be used to compress a pre-established pinch field, switch on an accelerating pinch field, or may itself be reconfigured to form an intense pinch. In any case, the high energy, high energy density, and high velocity possible with an accelerated compact torus can provide extremely high power to overcome, by a number of orders of magnitude, the limitations to pinch formation described earlier. In this paper we will consider in detail pinches formed by reconfiguration of the compact torus.

27570 **Review of recent experimental and theoretical laser-plasma research carried out at Soreq.** Eliezer, S.; Arad, B.; Borowitz, A.; Gazit, Y.; Gilath, I.; Jackel, S.; Krumbein, A.D.; Lalluz, R.; Loebenstein, H.M.; Ludmirsky, A. . (Soreq Nuclear Research Centre Yavne 70600). pp 417-436 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on the study of laser produced plasmas and laser produced shock waves using a set of different oscillators and an Nd: glass laser system. Topics covered include the laser system, laser light reflection and absorption, momentum measurements, electron-ion decay instability, the measurement of return currents and self-similar expansion, shock wave measurements, the spectra of highly ionized Cd, In, Sn and Te atoms, two dimensional x-ray spectroscopy of laser produced plasma, calculation of laser produced compression and pressure, the use of effective Feynman diagrams for atomic cross-section calculations, non-local-thermodynamic-equilibrium (LTE) models, and stochastic analysis in laser generated plasma. Presents a table and 2 diagrams.

27571 **Suprathermal electron generation transport and deposition in CO_2 laser irradiated targets.** Hauer, A.; van Hulsteyn, D.; Begay, F.; Goldman, R.; Kephart, J.; Kristal, R.; Mitchell, K.; Mueller, M.; Oona, H.; Stover, E. . (Los Alamos National Laboratory, Univ. of California, Los Alamos, NM). pp 479-492 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter investigates the absorption and subsequent partitioning of CO_2 laser energy incident on solid targets. Topics covered include laser absorption and hot electron generation; fast ion measurement and theory; and hot electron transport in relation to deposition and energy balance. Calorimetric measurements demonstrate high CO_2 laser absorption at high intensities. The high efficiency of conversion of laser energy to energetic ions is measured. New modeling techniques involving self consistent B fields are used to calculate many aspects of hot electron coupling to fast ions. Strong experimental evidence for non-diffusive lateral transport of hot electron energy is presented. It is demonstrated that x-ray and calorimetric measurements provide a good overall picture of fast electron energy partitioning. Includes 2 tables and 4 photos.

27572 **Absorption, double layers, and dynamics at laser-plasma interaction and pellet fusion gains with reheat.** Cicchitelli, L.; Dragila, R.; Golden, K.I.; Goldsworthy, M.P.; Hora, H.; Jones, D.A.; Kemeny, L.G.; Kentwell, G.W.; Lalousis, P.; Tubbenhauer, G. (Dept. of Theoretical Physics Univ. of New South Wales, Kensington-Sydney). pp 437-459 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter investigates absorption phenomena, electrostatic double layers, and laser fusion. Topics covered include quantum correction for optical absorption and anomalous resistivity; absorption by a new collision term in Ohm's law; collisionless absorption by time dependent nonlinear forces; plasma dynamics; nuclear fusion gains; reheat by alphas; and volume ignition with collective reheat and spin polarization. Direct derivation of the plasma-two-fluid equation covering the most general equation of plasma motion at monochromatic laser interaction introduced a new collision term which is related to solitons at special conditions and may explain the reduced thermal conduction in nonlinear-force steepened density profiles. Formulation of the nonlinear force for very short optical wave packets with respect to the Poynting vector is discussed. Inertial confinement with light ions has achieved ten times higher fusion gains than the best tokamak at a hundred times lower cost. Pellet fusion gains are calculated and compared with 50% higher cross sections for spin polarized nuclei whose relaxation times are found to be sufficiently long for pellet densities. Includes 1 table.

27573 **Scaling of laser-plasma interactions with laser wavelength and plasma size.** Max, C.E.; Campbell, E.M.; Estabrook, K.G.; Kruer, W.L.; Lasinski, B.F.; Mead, W.C.; Phillion, D.W.; Turner, R.E. (Lawrence Livermore National Lab. Livermore, CA 94550). pp 507-526 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984). Contract W-7405-ENG-48.

This chapter reports on work done at the Lawrence Livermore National Laboratory which demonstrated that plasma size is an important parameter in wavelength-scaling experiments because it determines both the threshold and potential gain for a variety of laser-plasma instabilities. Topics covered include thresholds for instabilities, Raman scatter, stimulated Brillouin scatter, two-plasmon decay instability, filamentation due to ponderomotive force, Raman scatter in an Argus laser experiment, evidence for strong instabilities in a Shiva laser experiment, filamentation in Argus laser experiments, thermal filamentation, and the role of inhomogeneities on the incident laser beam. It is graphically illustrated that a concerted effort is needed to field experiments with larger plasmas, so as to begin approaching the parameters typical of reactor-scale targets. The evidence presented for Raman scatter, filamentation, and the two-plasmon decay instability needs to be confirmed in experiments which measure several instability signatures simultaneously, and which produce more quantitative information about the local density and temperature profiles. Includes 4 photos and a diagram.

27574 **Recent advances in microwave simulation of laser-plasma interactions.** DeGroot, J.S.; Hargreaves, T.A.; James, R.A.; Kodis, M.A.; Mizuno, K.; Ng, E.W.Y.; Rambo, P.W.; Rasmussen, D.A.; Rogers, J.H.; Woo, W. (Dept. of Applied Science, Univ. of California, Davis, CA 95616). pp 561-576 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports results from measurements on several effects that can occur in laser driven pellets. Topics covered include electron heating and heat flux inhibition; hot electron generation due to resonance absorption; ion acoustic decay and oscillating two stream instability; hot electron generation; thermal electron heating and heat flux inhibition due to ion turbulence; hot electron generation due to the two-plasmon instability; and Stimulated Brillouin Scattering (SBS). Processes that strongly affect pellet performance are isolated by using theory and simulation calculations. Microwave driven experiments are designed to model these processes. Careful attention is given to scaling laws and the effect of boundary conditions so that the results apply to an important range of variables that occur in a laser driven pellet. The measurements are compared to theory, computer simulation calculations, and laser experiments for verification. Includes 2 schematic drawings.

27575 **Critical elements of high gain: An update.** Bodner, S. (Naval Research Lab. Washington, DC 20375). pp 665-672 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter discusses three problem areas concerning the direct drive concept in relation to pellet gains. Rocket efficiencies are substantially lower in spherical geometry as opposed to a flat target model. Efficiencies reach 15-20% only with short 1/4 μm lasers and without smoothing requirements. Reduced efficiency (from 20% down to 7%) implies a lower best-case pellet gain. Energy transport issues are affected by the failure of the flux limiter concept in two-dimensional analysis. Progress in producing a relatively uniform and controllable laser profile on target has been slow. Topics covered include hydrodynamic efficiency, flux limiters, and laser uniformity. Includes 1 photo.

27576 **Analysis of stability and symmetry implications for ICF.** Gardner, J.H.; Bodner, S.E.; Boris, J.P.; Emery, M.H.; Fritts, M.J.; Herbst, M.J. (Naval Research Lab. Washington, DC 20375). pp 673-691 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on the theoretical and computational work that has been carried out in connection with the experimental work at the Naval Research Laboratory (NRL) in evaluating the design constraints that are imposed primarily by the symmetry and stability requirements on directly-driven laser fusion targets. The results are primarily based on numerical simulations with many of the results verified by experiments performed at NRL. Symmetry and Rayleigh-Taylor stability analysis were performed using the FAST2D laser-shell simulation code. Results reported include the requirements for thermal smoothing of laser nonuniformities, reduced Rayleigh-Taylor growth rates and saturation via the nonlinear Kelvin-Helmhotz shear flow, a new theory based on vortex shedding that explains the reduced linear Rayleigh-Taylor growth rates, and a possible wavelength-intensity window for high gain direct illumination where the requirements of target velocity, symmetry, and now also efficiency can be simultaneously met. It is demonstrated that unless an alternative is found to smoothing of laser nonuniformities, short wavelength lasers will have difficulties providing sufficient smoothing for reactor size inertial confinement fusion (ICF) targets.

27577 **Direct illumination spherical target experiments.** Johnson, R.R. (Fusion Experiments Dept. KMS Fusion, Inc. Ann Arbor, MI). pp 693-708 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984). Contract AC08-82DP40152.

This chapter reports on a set of spherical target experiments designed to evaluate the effectiveness of achieving higher convergence ratio implosions using cryogenically frozen fuel layers, submicron wavelength laser light, and temporally tailored pulse shapes. Topics covered include the experimental facilities (a tow beam Chroma laser; a triple bounce ellipsoidal mirror system); direct illumination cryogenic implosion experiments; and numerical simulations and interpretation. Numerical simulations were performed using the one-dimensional hydrodynamics code TRHYD, which includes radiation, a realistic equation of state, and a multi-group diffusion treatment for non-thermal electrons. The calculations indicate that the 1.05 μm temporally flat-topped cryogenic implosion experiments are dominated by hot electrons. The numerical studies show that by combining shorter wavelength illumination, cryogenic fuel layers and properly shaped laser pulses, the ideal Fermi degenerate adiabat can be approached.

27578 **Investigation of hydrodynamic stability of high aspect ratio targets in laser implosion experiments.** Dufour, J.M.; Galmiche, D.; Sitt, B. (Commissariat a l'Energie Atomique Centre d'Etudes de Limeil B.P. No 27 - 94190 Villeneuve-St. Georges). pp 709-730 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter examines the experimental results of the implosion of very high aspect ratio microballoons partly consistent with 1-D numerical simulations using a rigorous analytical treatment of the phase of linear instability associated with some phenomenological models describing "extreme" types of behavior of thermal effects. The CAMELIA experiments were performed using the 8-beam, 1.06 μm OCTAL laser system. Topics covered include analysis of a particular targets, investigations of hydrodynamic instabilities, numerical modeling of linear perturbations, the irradiation pattern of the OCTAL laser, instabilities induced by non-uniform laser irradiation, and instabilities induced by target defects. It is concluded that a small amount of suprathermal preheating efficiency protects the imploding shell against break-up; the classical Rayleigh-Taylor instability is not critical for type of target/long pulse combination; and implosion uniform is notably improved by acoustic smoothing, but remains highly sensitive to large scale illumination defects, because of the instability of a converging shock to low-order harmonic modes, which can strongly affect the final uniformity of the target core. Includes 2 spherical maps.

27579 **Thermal transport measurements in 1.05 um laser irradiation of spherical targets.** Yaakobi, B.; Boehly, T.; Delettrez, J.; Hutchinson, R.; Letzring, S.; Marjoribanks, R.; McCrory, R.L.; Richardson, M.C.; Shvarts, D.; Soures, J.M. . (Lab. for Laser Energetics College of Eng. and Applied Science Univ. of Rochester 250 East River Rd., Rochester, NY 14623). pp 731-750 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984). Contract AC08-80DP40124.

This chapter reports on transport and implosion experiments conducted on the OMEGA, 24-beam, uniform-irradiation facility which may influence the understanding of thermal transport in laser-irradiated targets. Topics covered include transport determination by burnthrough measurements, preheat determination using Kα lines, the mass ablation rate, and implosion experiments. It is demonstrated that transport in 1.05 μm laser irradiation cannot be adequately described by a flux-limited model but is in general agreement with multi-group treatments of transport. The enhanced inward penetration appears to supercede preheat by resonance-absorption electrons, but to have a weaker dependence on the irradiance than is the case for the latter mechanism. The target implosion experiments show higher core temperatures than predicted by an inhibited flux model and lower densities than predicted by an uninhibited flux model. It is indicated that in short wavelength irradiation the higher collisionality suppresses the deeper penetration measured.

27580 **Uniformity of energy deposition for laser driven fusion.** Skupsky, S.; Craxton, R.S.; Delettrez, J.; Epstein, R.; Lee, K.; McCrory, R.L.; Verdon, C. (Lab. for Laser Energetics Univ. of Rochester 250 East River Rd. Rochester, NY 14623). pp 751-774 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984). Contract AC08-80DP40124.

This chapter examines the characteristic nonuniformities produced by laser irradiation, with multiple overlapping beams, for a variety of laser-target configurations. The results from the geometrical effects related to the number and orientation of the laser beams are distinguished from the details of ray trajectories for the overlapping beams. Emphasis is placed on the wavelength of the nonuniformities in addition to their magnitudes, as the shorter wavelength nonuniformities are more easily smoothed by thermal conduction within the target. The nonuniformity that reaches the ablation surface and drives the target is estimated using a thermal smoothing model. The effects of specific laser-target conditions are illustrated using the 24-beam OMEGA laser system at the University of Rochester, and a 32-beam system ("truncated" icosahedron) comprised of beams whose axes penetrate the centers of the 20 faces and the 12 vertices of an icosahedron. The degradation in target performance caused by laser nonuniformities is shown. It is demonstrated how the geometrical symmetry of the laser system effectively eliminates the longer wavelengths, and how shorter wavelength nonuniformities can be "tuned out" by varying parameters such as the focal position and the radial intensity profile of the beam. Includes 3 tables, 1 photo, and 3 drawings.

27581 **Rayleigh-Taylor instability and resulting failure modes of ablatively imploded inertial fusion targets.** Montierth, L.; Morse, R. (Nuclear & Energy Engineering Univ. of Arizona Tucson, AZ 85721). pp 775-795 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter discusses small amplitude growth of the outside surface instability and modes of failure resulting from nonlinear development of the inside surface instability. It is demonstrated that pellets with initial pellet aspect ratio, A /SUB p/ >5 may have difficulty with Rayleigh-Taylor instability and that shells with A / SUB p/ $\geqq 10$ will probably demand stringent smoothness specification in order not to experience failure in the final implosion. The linear amplification of the outside surface instability can easily exceed 10^3 for A /SUB p/ and resulting A values in the range of programmatic interest. Amplifications of this order, starting from attainable surface finishes, can then penetrate to the inside shell surface, producing perturbations there which approach the nonlinear development amplitude and at the start of the final deceleration. It is shown that such inside surface perturbations can be amplified to large amplitude by the inside instability and cause failure through reduction of the maximum fuel temperature achieved. Insight into the scaling of failure mechanisms is offered.

27582 **High density transition laser driven implosions.** Bayer, C.; Bernard, M.; Decroisette, M.; Juraszek, D.; Meynial, D. (Centre d'etudes de Limeil B.P. 27, 94190 Villeneuve-Saint-Georges). pp 797-815 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter discusses implosion studies which explore the transition between exploding and ablative regimes. Several laboratories have been involved in transition implosions, where both lengthening of the laser pulse and thickening of the pusher wall lead to a more ablative regime than the exploding pusher. The experiments examined utilize the eight beams laser facility Octal and plastic coated glass microballoons irradiated in cubic geometry. X-ray shadowgraphy is developed as a suitable diagnostic for ablative target probing. Numerical simulations as performed with a 1-D Lagrangian code, with emphasis on the description of suprathermal transport. The preheat factors are reduced and the laser→fuel energy transfer is optimized by imploding thickened targets with intermediate laser pulse (500 ps). It is demonstrated that the thickness of the target shell increases the pusher, lowers the preheat and in-

duces a more ablative behavior. A maximum in final DT density is observed. Includes 2 tables, 1 drawing, and 5 photos.

27583 **X-ray emission experiments at 1.06 μm and 0.35 μm.** Babonneau, D.; Billon, D.; Bocher, J.L.; Di Bona, G.; Fortin, X.; Thiell, G. (Commissariat a l'Energie Atomique Centre d'Etudes de Limeil B.P. 27, 94190 Villeneuve-Saint-Georges). pp 817-837 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on experiments concerning high-Z target X-ray emission conducted at the Limeil laboratory. X-ray spectra and conversion efficiencies are studied as a function of laser flux at 0.35 μm and 1.06 μm on gold targets, and target Z at 0.35 μm on aluminium, copper, silver, and gold. Spherical targets with Octal laser and planar targets with P102 laser are used. The influence of the different parameters (laser flux, laser wavelength, atomic number) on emission rates and spectra is discussed. Space-time resolved measurements are made with a streak camera from spherical targets. Spherical microballoons are irradiated with incident laser fluxes from 3×10^{13} to 3×10^{15} W/cm^2. The conversion rate decreases from 20% to 5% in this range. It is demonstrated that the conversion efficiency increases as Z increases. An analytical expression is proposed giving the X-ray conversion rates. Includes 3 tables, 3 drawings and 3 photos.

27584 **Laser implosion fusion experiments at Ile Osaka.** Nakai, S.; Izawa, Y.; Kato, Y.; Kitagawa, Y.; Mochizuki, T.; Nakatsuka, M.; Yamanaka, C.; Yamanaka, M.; Yamanaka, T.; Yoshida, K. (Inst. of Laser Engineering Osaka Univ. Osaka 565). pp 839-855 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter investigates the scaling laws for ablative compression driven by either thermal electrons, hot electrons or X-ray radiations as well as non-ablative compression (Cannon ball target), by applying the "GEKKO" glass lasers and its higher harmonics, and the "LEKKO" CO_2 laser. Topics covered include energy drivers, scaling of implosion pressure, hot electron driven ablation, X-ray driven ablation, and the implosion process in various targets. Ablation properties of different wavelength irradiation (10 μm, 1 μm and its 2nd and 3rd harmonics and X-ray) are studied. Shorter wavelength irradiation, especially soft X-ray, is observed to have high efficiency in generating the ablation pressure. Hot electron driven ablation is verified to be effective in driving the pellet implosion. It is demonstrated that the quantitative evaluations of the pre-heat, and R-T or nonuniformity instability on pellet implosion are the key issues for obtaining high compression. Cannon ball targets, double shell and foam ablator structures are compared to evaluate the performance of inertial confinement fusion (ICF) examining the absorption, hydrodynamic efficiency, uniformity improvement effect, and preheat reduction. Includes 2 tables, 3 drawings, and 18 photos.

27585 **Theoretical and computational investigation on implosion process.** Yabe, T.; Mima, K.; Nishiguchi, A.; Nishihara, K.; Yamanaka, C. (Inst. of Laser Engineering Osaka Univ. Suita, Osaka 565). pp 857-868 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter examines hydrodynamic implosion uniformities in inertial confinement fusion. A hydrodynamic simulation code is used which employs Lagrangian fluid particles and moving grids. The convering amplification instability due to the angular momentum conservation is investigated by comparing the simulation results with analytical estimations. The analysis shows that the instability could be dangerous when it is coupled with hot electron and/or radiation transport. Criteria for an initial nonuniformity are given in terms of the mach number of the imploding shell target. The degradation of fusion reaction in a strongly deformed target is estimated.

27586 **Recent studies in electron transport and laser interaction at INRS-energie.** Pepin, H.; Johnston, T.W.; Kieffer, J.C.; Lavigne, P.; Martin, F.; Matte, J.P.; McCarthy, N.; Pascale, D.; Picard, G.; Piche, M. (INRS-Energie, Univ. du Quebec Varennes, JOL 2PO). pp 869-891 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on experiments concerning hot electron transport, spectroscopy and calorimetry of scattered radiation, and Fokker-Planck study of electron heat flow. The experiments were conducted at a CO_2 laser facility giving a 50 J, 1.2 nsec (FWHM) pulse, with a rise time of 0.4 nsec. Energy levels up to 15 J were focused onto the target by a f/1.5, 15 cm focal length, off axis parabolic mirror. Topics covered include x-ray angular distribution, deformation of the incident electron distribution in plastic, energy deposited by hot electrons, axial transport, lateral transport, backscatter measurement, and specular scattering. The results indicate that the inward transport to a conducting substrate can be described by the classical penetration of an incident hot electron distribution. The lateral energy transport by hot electrons produces a nonuniform radial energy deposition over a large area of the target surface. It is demonstrated that plasma can scatter energy at other angles than the privileged backscatter and specular direction. Includes 2 photos.

27587 **Progress toward direct drive laser fusion.** Richardson, M.C.; Boehly, T.R.; Brinker, B.A.; Bristow, T.C.; Craxton, R.S.; Delettrez, J.A.; Enright, G.; Entenberg, A.; Friedman, W.; Goldman, L.M. . (Lab. for Laser Energetics Univ. of Rochester 250 East River Road Rochester, NY 14623). pp 903-925 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984). Contract AC08-80DP40124.

This chapter reviews the recent progress in the three interrelated areas of irradiation uniformity, coronal physics and ablatively driven spherical shell implosions, all of immediate relevance to direct drive laser fusion. Diagnosis of the fuel during the implosion and at final compression, including direct measurement of fuel density-radius product is made through a variety of techniques involving space, time and spectral x-ray analysis and scattered reaction product spectrometry. The 24-beam OMEGA, Nd:glass laser system operating with 2-3 kJ, 1 ns, 1.054 μm pulses has been used to examine a number of physics issues central to the success of direct drive laser fusion. This system provides the capability to irradiate spherical targets with a high degree of irradiation uniformity with precisely temporally and spatially aligned beams on target. The technical progress made in perfecting the output characteristics of OMEGA, and the formulation of an approach to define multi-beam uniformity in spherical geometry, provide some optimism that the factor of 4-5 improvement in irradiation uniformity necessary for high performance targets can be attained. The coronal physics experiments performed under spherical geometric irradiation reveal shortcomings in the current understanding of electron energy transport. Includes 13 photos and 4 drawings.

27588 **Historical remarks on beam fusion.** Hora, H. (Dept. of Theoretical Physics Univ. of New South Wales, Kensington-Sydney). pp 927-935 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter discusses the complicated physics of beam fusion, including recent developments of electrostatic double layer effects in plasmas. An interpenetration model for self-sustained fusion combustion in solid DT is presented with a threshold of 2×10^7 J/cm^2. Topics covered include the condemnation of beam fusion, the revival of beam fusion, and errors in the past development of fusion research. CO_2 lasers may be used to initiate the discussed boots trap process by utilizing nonlinear force effects to generate space charge neutral ion beam densities exceeding 10^9 Amp/cm^2. Based on the experience of the development of fusion research, the scientific development is considered and a motivation is given for devising fusion programs that will lead to the early achievement of fusion energy.

27589 **Advances in ICF using light ion beams.** Yonas, G.; VanDevender, J.P. (Sandia National Lab. Albuquerque, NM 87185). pp 937-956 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on how PBFA II, with parameters of 3.5 MJ and 100 TW, is being designed to allow inertial fusion ignition experiments using imploding foils or light ions beams. Experiments on Proto II and PBFA I are providing the information necessary to proceed with the final design of PBFA II. Imploding foil data on Proto II has demonstrated that electromagnetic energy can be efficiently converted into foil kinetic energy with the output increasing as the square of the foil current. This implosion demonstrates adequate stability, and modeling has shown that this behavior should extrapolate to higher currents if the implosion time is less than 100 ns. Proto II is modified for a lower inductance power feed in order to extend the scaling data to 8 MA. PBFA II will be capable of operating over a wide voltage range to accomodate the different options, with scaling experiments on PBFA I providing the basis for the selection. It is concluded that after the power concentration issues are resolved on PBFA II, the challenging problems of implosion hydrodynamics can be confronted with sufficient diagnostics to determine the feasibility of ignition. Includes a table, 5 photos, and 7 drawings.

27590 **Status of light ion inertial fusion research at NRL.** Cooperstein, G.; Barker, R.J.; Colombant, D.G.; Goldstein, S.A.; Meger, R.A.; Mosher, D.; Neri, J.M.; Ottinger, P.F. (Naval Research Lab. Washington, DC 20375). pp 957-979 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on the use of high-brightness proton beams, extracted from axial pinch-reflex diodes mounted on the Naval Research Laboratory (NRL) Gamble II generator, to study light ion inertial fusion. Topics covered include the modular approach, ion beam brightness studies, light-ion beam transport, final focusing, the single diode approach, the inductive storage approach, an energy loss experiment, and future plans. Analysis of a modular inertial confinement fusion (ICF) system using axial pinch-reflex diodes shows that an operational window for transport of light-ion species exists. A proof-of-principle experiment for the required final focusing cell was conducted on Gamble II. Preliminary experiments using vacuum inductive storage and plasma opening switches have demonstrated factorof-three pulse compressions, with corresponding power and voltage multiplications for pulse durations of interest to PBFA II. The stopping power of deuterons in hot plasmas was measured in other experiments. It is demonstrated that about 40% enhancement in stopping power over that in cold targets when the deuteron beam is focused on the target to about .25 MA/cm^2. Includes 6 diagrams.

27591 **Inertial confinement fusion by light ion beam.** Miyamoto, S.; Higaki, S.; Imasaki, K.; Nakai, S.; Ozaki, T.; Yamanaka, C.; Yoshinouch, A. (Inst. of Laser Engineering Osaka Univ. Suita, Osaka, 565). pp 981-995 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter examines the key issues for the light ion beam (LIB) inertial confinement fusion (ICF) system based on the conceptual design of the ROKKO I reactor. Topics covered include ion beam generation, beam divergence and focusing, beam transport, and target experiments (stopping power and ablation pressure). A simulation calculation using the hydrodynamic code ABLATE was performed. The conceptual design of the ROKKO I includes the development of the pulse power technology, the development of diagnostics for high power beam and target experiments, beam generation and concentration of the energy in time and space, beam transport through a laser guided plasma channel, the investigation of the beam-target coupling physics and the scaling of the ablation pressure on power density, and implosion simulation and pellet design. Includes 6 drawings and 7 photos.

27592 **Propagation and space focusing in vacuum.** Phelps, D.A.; Chang, D.B.; Fisher, A.; Jorna, S.; Rostoker, N.; Salisbury, W.W.; Thompson, W.B.; Wharton, C.B. pp 997-1011 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reports on experiments on the propagation and space focusing in vacuum of 200ns pulse of 100-500 kV and 0.1-1A/cm^2 alkali plasma beams. Topics include the ion accelerator, the electron neutralizer, plasma beam propagation experiments, beam bunching experiments, and plasma beam propagation theory. A plasma beam equilibrium and stability theory is presented which accounts for initial, thermal, and space-charge contributions to beam focusing. The theory deduces an effective lleV transverse temperature, relates this temperature to various sources of electron and ion emittance, and predicts that plasma beams accelerated to practical super power generator potentials of 5-15 MeV would realize the sub milli-radian angular divergence profiles observed in computer simulation experiments. Experiments on plasma beam time focusing in vacuum are also reported. A theory is presented which demonstrates that the observed time focusing could only be accomplished for less than 1% deviations from the appropriate voltage ramp, thereby establishing experimentally the accuracy of the ORCA-I precision tapered pulseline. Includes 4 drawings.

27593 **Ion beam interactions with ICF targets.** Bangerter, R.O. (Univ. of California Los Alamos National Lab. Los Alamos, NM 87545). pp 1013-1027 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter shows how low-intensity beams can be used to determine whether the ion beam target interaction is suitable for inertial confinement fusion (ICF) targets. Topics covered include the effect of uncertainties in energy loss on predictions of target performance; target conditions; single particle theory; plasma instabilities; preheat; knock-on electrons and ions; electrons from plasma instabilities; x-rays; charged nuclear debris; and neutrons. It is concluded that ion-target interaction appears suitable for ICF for at least some typical choices of beam and target parameters. More experimental work in hot plasmas and on targets with high-Z tampers is recommended. Includes a drawing of a typical spherical ion beam target.

27594 **Ions stopping in ICF plasmas.** Deutsch, C.; Maynard, G.; Minoo, H. (Lab. de Physique des Plasmas Bat. 212, Univ. Paris XI 91405 Orsay Cedex). pp 1029-1048 of Laser Interaction and Related Plasma Phenomena. Hora, H. New York, NY; Plenum Publishing Corp. (1984).

This chapter demonstrates how the exact random-phase approximation dielectric function can be used to compute the energy loss and straggling of nonrelativistic charged particles in very dense electron fluids (r /SUB s/ $\leqq$ 1) at any degeneracy and for any velocity ratio V/V /SUB F/ . Stopping powers, range data and deposition times are computed. Topics covered include partially degenerate electron fluid; energy loss at finite temperatures; and stopping by bound electrons. The distant collision part of the $Z^3{}_1$-contribution to the stopping of nonrelativistic ions by bound electrons is written in a compact analytical form. Its magnitude is considered for a few species through a structure-dependent electron-ion effective interaction (GSZ potential). Ion-driven inertial fusion is emphasized. Includes 4 tables.

27595 **ICF Reactor using A ^{3}He-AFLINT tritium self-sufficient target.** Miley, G.H.; Adams, B.; Choi, C.K.; Ragheb, M.; Stubbins, J.F. (Fusion Studies Lab. Univ. of Illinois Urbana, IL 61801). pp 1049-1059 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter considers a D-fueled target (the "AFLINT" concept) which is used to investigate alternate fuel configurations that enable tritium to be bred within the target itself and provide a significant advantage for inertial confinement fusion (ICF) reactors since a complicated tritium breeding blanket can be avoided. Topics covered include target and driver characteristics; reactor chamber design; AFLINT chamber conceptual design; and alter-

nate chamber possibilities. A target design is proposed that achieves an internal Tritium Breeding Ratio (TBR) of 1.1. This study suggests that tritium self-sufficient AFLINT targets can provide adequate recycling of tritium and ^{3}He to manufacture subsequent targets. It is concluded that the ^{3}He-AFLINT and dual liquid-fall reactor chamber represent a potentially attractive approach to ICF power plants. Includes 3 tables and 3 diagrams.

27596 **Conceptual design of ICF reactor SENRI, Part II. Advances in design and pellet gain scaling.** Ido, S.; Mima, K.; Nakai, S.; Tsuji, R.; Yamanaka, C. (Inst. of Laser Engineering Osaka Univ. Suita, Osaka 565). pp 1061-1081 of Laser Interaction and Related Plasma Phenomena. Hora, H.; Miley, G.H. New York, NY; Plenum Publishing Corp. (1984).

This chapter reviews the recent design studies on reactor concepts with magnetically guided lithium flow, SENRI-I, SENRI-IA and SENRI-II. The routes from the present status to power reactors and an advanced fuel pellet concept is also discussed. Topics covered include pellet design, magnetohydrodynamic design of liquid lithium flow; reactor cavity concepts with magnetically guided lithium flow, a thermo-hydraulic analysis, a tritium recovery system; and an advanced fuel pellet concept for an inertial confinement fusion (ICF) reactor without a tritium breeding blanket. An advanced fuel pellet for an ICF reactor without a T breeder was studied in the model calculations, which showed sufficiently high values of pellet gain. Includes a table and 8 diagrams.

27597 **Vertical poloidal asymmetries of low-Z element radiation in the PDX tokamak.** Brau, K.; Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Wong, S.K. (GA Technologies, Inc., San Diego, CA (USA)). *Nuclear Fusion;* **23**: No. 12, 1657-1668(Dec 1983).

Vertical poloidal asymmetries of hydrogen isotopes and low-Z impurity radiation in the PDX tokamak may be caused by poloidally asymmetric sources of these elements at gas inlet valves, limiters or vacuum vessel walls, asymmetric magnetic-field geometry in the region beyond the plasma boundary, or by ion curvature drifts. Low ionization states of carbon (C II to C IV) are more easily affected by edge conditions than is C V. Vertical poloidal asymmetries of C V are correlated with the direction of the toroidal field. The magnitude of the asymmetry agrees with the predictions of a quasi-fluid neoclassical model. Experimental data and numerical simulations are presented to investigate different models of impurity poloidal asymmetries.

27598 **Locally omnigenous tandem mirror design.** D'Ippolito, D.A.; Francis, G.L.; Myra, J.R. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). *Nuclear Fusion;* **23**: No. 12, 1698-1701(Dec 1983).

Letter-to-the-editor.

A simple tandem-mirror coil system is found which has the property that the geodesic curvature of the paraxial magnetic field is locally small everywhere. This design approaches the ideal of a 'locally omnigenous' configuration in which the particle drift surfaces coincide with the magnetic flux surfaces. Thus, radial losses due to resonant ion and stochastic radial diffusion are minimized. Plasma distortion due to central-cell parallel currents and instability due to trapped particles are also greatly reduced. The advantages and disadvantages of the design for reactor applications are discussed.

27599 **A heat pipe concept for cooling a liquid-pool blanket of a tandem mirror fusion reactor.** Schwertz, N.L.; Hoffman, M.A. (University of California, Department of Mechanical Engineering Davis, California 95616). *Nuclear Technology;* **4**: No. 3, 479-490(Nov 1983). Contract W-7405-ENG-48.

The performance potential of a heat pipe designed specifically to operate in the high magnetic fields of a fusion reactor is investigated analytically. The heat pipe has a thin, flat cross section aligned parallel to the magnetic field so as to reduce the eddy currents and the resultant magnetohydrodynamic pressure drops in the liquid wick flow. The flat heat pipes are used to cool a pool of liquid lithium (or lithium-lead eutectic) in the blanket that surrounds the central-cell plasma of a tandem mirror fusion reactor. Calculations indicate that this new heat pipe design may be able to transport up to about 6800 W/cm^2 of condenser cross-sectional area in a 2-T magnetic field. This is considerably higher than the 420 W/cm^2 capability of a conventional cylindrical heat pipe of similar dimensions employing a channel wick and operating in the same 2-T field.

27600 **Helium-cooled solid breeder blanket design for a tokamak fusion reactor.** Huggenberger, M.; Schultz, K.R. (Swiss Federal Institute for Reactor Research (EIR) 5303 Wurenlingen). *Nuclear Technology;* **4**: No. 3, 456-467(Nov 1983).

A preliminary design for a helium-cooled solid breeder blanket for a tokamak fusion reactor has been developed, and its performance looks quite good. The design is capable of bearing a 4 MW/m^2 neutron wall load, and the ideal pumping power required for the whole primary helium loop including the steam generators is only 2.5% of the total thermal power. The maximum blanket thickness including the helium duct work is only 860 mm, the minimum thickness is only 730 mm. The design work was focused on the thermalhydraulic aspects, which represent the key problems associated with using helium as a coolant. The present work demonstrates that the potential disadvantages helium has, due to its limited heat transfer capabilities, can be avoided or minimized by an appropriate thermal-hydraulic design. As a result, helium with its many advantages remains a promising fusion blanket coolant.

27601 **Prospects for low-activity aluminum structures.** Powell, J.R.; Fillo, J.A. (Brookhaven National Laboratory Department of Nuclear Energy, Upton, New York 11973). *Nuclear Technology;* **4**: No. 3, 561-565(Nov 1983).

High-purity, low-activity powder metallurgy aluminum alloys can be developed for use in a fusion reactor at 300 to 400°C using helium as a heat transfer medium. Hot water as a coolant may limit aluminum to 200°C. From a heat transfer point of view, based on the dual- or two-temperature design approach, commercial fusion reactor blanket designs appear to be feasible. To meet all of the blanket design requirements feasibility requires quantification of thermal hydraulics, materials, neutronics, and material responses. Also, radiation damage and lifetime analyses are key issues for design qualification. Based on tests performed to date, aluminum appears well suited for experimental fusion reactors operating at wall temperatures below 200°C.

27602 **Preface: Radioactivation of Fusion Structures.** Stauber, M.C. (Grumman Aerospace Corporation, Research and Development Center Bethpage, New York 11714). *Nuclear Technology;* **4**: No. 3, 522-527(Nov 1983).

The following six papers represent a cross section of the invited presentations made in two special sessions at the 1982 Winter Meeting of the American Nuclear Society (ANS) in Washington, D.C., on the subject of "Radioactivation of Fusion Structures." Additional papers from these special sessions are expected to be published in a forthcoming issue of this journal. Plans for this "mini-symposium" originated within the ANS Isotopes and Radiation Division and were carried forward in collaboration with members of the ANS Fusion Energy, Radiation Protection and Shielding, and Materials Science and Technology Divisions. As the program for these sessions crystallized, it became apparent that the theme, "Radioactivation of Fusion Structures," might be too narrowly conceived and perhaps should include the coolant-breeder system. This broader viewpoint in fact was adopted in some of the papers.

27603 **Analysis of pumping requirement for exhausting duct in close vicinity of divertor in tokamak reactor.** Saito, S.; Abe, T.; Fujisawa, N.; Sugihara, M.; Ueda, K. (Japan Atomic Energy Research Institute Naka-muchi, Naka-gun, Ibaraki-ken). *Nuclear Technology;* **4**: No. 3, 498-507(Nov 1983).

An improved method for Monte Carlo simulation is described to calculate the neutral-particle transport in a divertor throat and to evaluate the helium removal efficiency from a burning plasma. The required pumping speed for the helium removal is discussed with special emphasis placed on the effects of long exhausting duct and of scrape-off plasma variables. The analysis for

International Tokamak Reactor (INTOR) single null divertor suggests a possibility that the pumping requirement for INTOR could be drastically eased--e.g., $<10^4$ l/s, for the high scrape-off plasma density of the order of 10^{13} cm^{-3}.

27604 **Radioactivation characteristics for the tokamak fusion test reactor.** Ku, L.; Kolibal, J.G. (Princeton University Plasma Physics Laboratory, Princeton, New Jersey 08544). *Nuclear Technology;* **4**: No. 3, 586-598(Nov 1983). Contract AC02-76CH03073.

Activation analysis has been conducted for several primary fusion blanket materials based on a model of a commercial tokamak fusion reactor design, STARFIRE. The blanket materials studied include two solid tritium breeders, viz., Li_2O and α-$LiAlO_2$, and four candidate structural materials, viz., PCA stainless steel, V15Cr5Ti, Ti6Al4V, and Al-6063 alloys. The importance of breeder material activation is identified in terms of its impurity contents such as potassium, iron, nickel, molybdenum, and zirconium trace elements. The breeder activation is also discussed with regard to its potential for recycling and its impact on the lithium resource requirements. The structural material activation is analyzed based on two measures, volumetric radioactivity concentration and contact biological dose due to decay gamma emission. Using the radioactivity concentration measure, it is revealed that a substantial advantage exists from a viewpoint of radwaste management, which is inherent in fusion reactor designs based on potential low-activation alloys such as V15Cr5Ti, Ti6Al4V, and Al-6063. On the other hand, from the dose standpoint, the V15Cr5Ti alloy is found to be the only alloy for which one could realize a significant dose reduction (below 2.5 mrem/h) within about 100 yr after shutdown, possibly by some extrapolation on alloy purification techniques.

27605 **Contribution of activation products to fusion accident risk: part II. Effects of alternative materials and designs.** Holdren, J.P.; Fetter, S. (University of California, Berkeley Energy and Resources Group, Berkeley, California 94720). *Nuclear Technology;* **4**: No. 3, 599-619(Nov 1983).

Comparison of accident-hazard potentials associated with neutron-activation products in fusion reactors of various designs and structural materials suffers from a number of shortcomings in the readily available hazard-index data. Neither inventories of curies nor biological hazard potentials (BHPs) are satisfactory indices of hazard even if consistently computed, and between-study inconsistencies in neutronics packages and BHP calculations further obscure the meaning of comparisons based on these measures. We present here the results of internally consistent calculations of radioactive inventories, BHPs, and off-site dose potentials associated with the first walls of nine reactor-design/first-wall-material combinations. A recent mirror-reactor design reduces off-site dose potentials by a factor of 2 compared to a muchstudied early tokamak, for a given first-wall material. Holding design fixed, HT-9 ferritic steel offers a factor of 2 reduction in dose potential compared to Type 316 stainless steel. By the dose-potential measure, molybdenum is the worst of the materials investigated and silicon carbide is by far the best. Hazards in realizable accidents depend not only on the hypothetical dose potentials, as calculated here, but also on the actual release fractions of first-wall (or other activated) material. Review of the theoretical and experimental evidence bearing on release fractions suggests that, for most candidate materials, high release fractions from designs containing liquid lithium cannot yet be convincingly ruled out.

27606 **An analysis of activation and the impact of tritium breeding media and structural materials for a commercial tokamak fusion reactor design.** Jung, J. (Fusion Power Program, Argonne National Laboratory 9700 South Cass Avenue, Argonne, Illinois 60439). *Nuclear Technology;* **4**: No. 3, 566-585(Nov 1983).

The characteristics of the neutron-induced radioactivities have been studied for the Tokamak Fusion Test Reactor (TFTR) on both the global and local scales. The global radioactivation properties are illustrated by the dose rate contours near the tokamak for a number of typical cases, based on two-dimensional poloidal model transport calculations. Although calculations on this scale require the omission of many details of the machine design, it nevertheless yields valuable information on the spatial variations of the doses. On the local scale, the activation properties of individual materials have been studied by a systematic analysis which covers a typical set of materials and neutron flux spectra. The data necessary to correlate the operational history, the object size, and the observational distances are presented so that interpolation or extrapolation of the activation properties can be made for the situations that have not been covered. The results yield the necessary correction to the global picture, and also provide the necessary information for the assessment of the problems associated with waste disposal, radioactive material transport, and decommissioning for the TFTR. Although the study is specifically for the TFTR, the methods of approach and the results should also be useful for the analysis of activation on other fusion devices.

27607 **Radioactivation characteristics for deuterium-tritium fusion reactors.** Cheng, E.T. (GA Technologies Inc., P.O. Box 85608 San Diego, California 92138). *Nuclear Technology;* **4**: No. 3, 545-560(Nov 1983). Contract AT03-76ET51011.

Deuterium-tritium fusion neutrons, peaked at 14.1 MeV, can activate the materials employed in a fusion reactor. The radioactivation characteristics and level of activation that occurs in a fusion reactor after shutdown depend on the elements that are activated, the neutron wall loading, the duration of the exposure, and the neutron flux spectrum present. The radioactivity resulting from potential elements considered in fusion reactor designs is discussed. The dominating radionuclides and the levels of activation resulting from exposure of these elements to the neutron flux spectrum in the first-wall region of a typical Li_2O solid-breeder fusion reactor blanket are also given.

27608 **Low activation fusion rationale.** Hopkins, G.R.; Cheng, E.T. (GA Technologies Inc., P.O. Box 85608 San Diego, California 92138). *Nuclear Technology;* **4**: No. 3, 528-544(Nov 1983).

The potential problems of radioactivation in the materials surrounding a neutron-producing fusion plasma were identified over 8 yrs ago. At the same time, the use of low activation materials such as graphite, silicon carbide (SiC), and aluminum alloys was proposed for the structural material in fusion power reactors as a way to greatly reduce the major problems of radioactivity resulting from the more conventional stainless steel materials. A brief review of the current status of the reasons for low activation fusion is presented. Design studies with the low activation materials are not covered here. The consequences of low activation fusion are compared with stainless steel fusion structures and it is found that the radioactivity after reactor shutdown, as measured in curies, may be reduced by a factor of 1,000,000. Even then, this limit is determined by impurities in the materials rather than the low activation materials themselves. Problems from decay heat with potential meltdown are reduced for aluminum and completely eliminated for SiC and graphite. Contact or hands-on maintenance may be performed in regions immediately behind the blanket that otherwise require fully remote operations. Small amounts of radioactive waste materials may be stored in surface facilities for the low activation concept. This is compared to the conventional steel systems where high-level radwaste geologic storage facilities may be required. Preliminary projected incremental costs for low activation fusion do not appear excessive but cost/benefit analyses are needed to evaluate the optimum degree of activation reduction. Low activation fusion can help assure the full potential of fusion in providing an environmentally benign energy source with a high degree of safety and public acceptance.

27609 **Materials for fusion.** Scott, J.L. (Oak Ridge National Lab., TN). *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 66-67(Fal 1983).

The plasma to be magnetically confined in commercial fusion power devices can be exceedingly hostile to its immediate surroundings, i.e., the materials making up the first wall and the structure holding the blanket used for breeding new fuel. The Oak Ridge National Laboratory's research program on the development of materials suitable for fusion reactors is briefly discussed.

27610 **Laser or charged-particle-beam fusion reactor with direct electric generation by magnetic flux compression.** Lasche, G.P. (to Dept. of Energy). US Patent Application 6-537,218. 29 Sep 1983. 87p. Contract W-7405-ENG-48.

Portions are illegible in microfiche products.

The invention is a laser or particle-beam-driven fusion reactor system which takes maximum advantage of both the very short pulsed nature of the energy release of inertial confinement fusion (ICF) and the very small volumes within which the thermonuclear burn takes place. The pulsed nature of ICF permits dynamic direct energy conversion schemes such as magnetohydrodynamic (MHD) generation and magnetic flux compression; the small volumes permit very compact blanket geometries. By fully exploiting these characteristics of ICF, it is possible to design a fusion reactor with exceptionally high power density, high net electric efficiency, and low neutron-induced radioactivity. The invention includes a compact blanket design and method and apparatus for obtaining energy utilizing the compact blanket.

27611 **Method to produce large, uniform hollow spherical shells.** Hendricks, C.D. (to Dept. of Energy). US Patent Application 6-535,464. 26 Sep 1983. 17p. Contract W-7405-ENG-48.

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The invention is a method to produce large uniform hollow spherical shells by (1) forming uniform size drops of heat decomposable or vaporizable material, (2) evaporating the drops to form dried particles, (3) coating the dried particles with a layer of shell forming material and (4) heating the composite particles to melt the outer layer and to decompose or vaporize the inner particle to form an expanding inner gas bubble. The expanding gas bubble forms the molten outer layer into a shell of relatively large diameter. By cycling the temperature and pressure on the molten shell, nonuniformities in wall thickness can be reduced. The method of the invention is utilized to produce large uniform spherical shells, in the millimeter to centimeter diameter size range, from a variety of materials and of high quality, including sphericity, concentricity and surface smoothness, for use as laser fusion or other inertial confinement fusion targets as well as other applications.

27612 **In-situ determination of energy species yields of intense particle beams.** Kugel, H.W.; Kaita, R. (to Dept. of Energy). US Patent Application 6-535,974. 26 Sep 1983. 38p. Contract AC02-76CH03073.

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Objects of the present invention are provided for a particle beam having a full energy component at least as great as 25 keV, which is directed onto a beamstop target, such that Rutherford backscattering, preferably near-surface backscattering occurs. The geometry, material composition and impurity concentration of the beam stop are predetermined, using any suitable conventional technique. The energy-yield characteristic response of backscattered particles is measured over a range of angles using a fast ion electrostatic analyzer having a microchannel plate array at its focal plane. The knee of the resulting yield curve, on a plot of yield versus energy, is analyzed to determine the energy species components of various beam particles having the same mass.

27613 **Small gap experiments in magnetically insulated transmission lines.** Stinnett, R.W.; Bengtson, R.; Palmer, M.A.; Spielman, R.B. (Sandia National Laboratories, Albuquerque, NM 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **11**: No. 3, 216-218(Sep 1983).

We have performed experiments using magnetically insulated transmission lines (MITL's) with anode-cathode gaps ranging from 0.15 to 0.40 cm. We have studied cathode plasma a formation using laser schlieren photography, time resolved visible photography, and visible spectroscopy. Cathode plasma formation occurs within 10 ns of the application of the voltage pulse. Densities of 10^{15} cm^{-3} 10^{17} cm^{-3} are inferred from the schlieren measurements. Negative ion formation in MITL's has also been observed which may result in losses in high-current-density small-gap power feeds.

27614 **Reflex ring laser amplifier system.** Summers, M.A. (to Dept. of Energy). US Patent Application 6-528,285. 31 Aug 1983. 16p. Contract W-7405-ENG-48.

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The invention is a method and apparatus for providing a reflex ring laser system for amplifying an input laser pulse. The invention is particularly useful in laser fusion experiments where efficient production of high-energy and high power laser pulses is required. The invention comprises a large aperture laser amplifier in an unstable ring resonator which includes a combination spatial filter and beam expander having a magnification greater than unity. An input pulse is injected into the resonator, e.g., through an aperture in an input mirror. The injected pulse passes through the amplifier and spatial filter/expander components on each pass around the ring. The unstable resonator is designed to permit only a predetermined number of passes before the amplified pulse exits the resonator. On the first pass through the amplifier, the beam fills only a small central region of the gain medium. On each successive pass, the beam has been expanded to fill the next concentric non-overlapping region of the gain medium.

27615 **Method and source for producing a high concentration of positively charged molecular hydrogen or deuterium ions.** Ehlers, K.W.; Leung, K.N. (to Dept. of Energy). US Patent Application 6-517,476. 26 Jul 1983. 22p. Contract AC03-76SF00098.

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One principal object of the present invention is to provide a novel method and apparatus for generating a high concentration of H_3^+ or D_3^+ ions by using a new and improved multicusp ion source. The basic principle in achieving a high percentage of H_3^+ or D_3^+ ions is to extract them from the source as soon as they are produced. Otherwise they will react with background gas molecules to form tri-atomic ions H_3^+ or D_3^+ or be dissociated by electrons. The former reaction $H_3^+ + H_2 \rightarrow H_3^+ + H$ can have a very short mean free path length λ. Assuming a background neutral gas density of approximately 3.3×10^{13} cm^{-3} and a cross-section σ of approximately 6×10^{-15} cm^2, $\lambda = (n_0\,\sigma)^{-1}$ is estimated to be about 5 cm. Thus the distance traversed by the H_3^+ ion before it arrives at the extractor electrode cannot exceed this value. This in turn sets a limit on the length of the source chamber.

27616 **Positioning apparatus.** Vogel, M.A.; Alter, P. (to Dept. of Energy). US Patent Application 6-511,702. 7 Jul 1983. 27p. Contract AC06-76FF02170.

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An apparatus is provided for precisely adjusting the position of an article relative to a beam emerging from a neutron source disposed in a housing. The apparatus includes a support pivotably mounted on a movable base plate and freely suspended therefrom. The support is gravity biased toward the housing and carries an article holder movable in a first direction longitudinally of the axis of said beam and normally urged into engagement against said housing. Means are provided for moving the base plate in two directions to effect movement of the suspended holder in two mutually perpendicular directions, respectively, normal to the axis of the beam.

27617 **Transverse field focused system.** Anderson, O.A. (to Dept. of Energy). US Patent Application 6-500,105. 1 Jun 1983. 18p. Contract AC03-76SF00098.

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It is an object of the invention to provide a transport apparatus for a high current negative-ion beam which will bend the beam around corners through a baffled path in a differential pump or a neutron trap. It is another object of the invention to provide a transport apparatus for a high current negative-ion beam which will allow gas molecules in the beam to exit outwardly from the transport apparatus. A further object of the invention is to provide a multi-stage accelerator for a high current negative-ion beam which will enable acceleration of the beam to very high energy levels with a minimum loss of current carrying capacity. A still further object of the invention is to provide an apparatus for transport or accelertion of a sheet beam of negative ions which is shaped to confine the beam against divergence or expansion.

27618 **Variable control of neutron albedo in toroidal fusion devices.** Jassby, D.L.; Micklich, B.J. (to Dept. of Energy). US Patent Application 6-500,199. 1 Jun 1983. 44p. Contract AC02-76CH03073.

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This invention pertains to methods of controlling in the steady state, neutron albedo in toroidal fusion devices, and in particular, to methods of controlling the flux and energy distribution of collided neutrons which are incident on an outboard wall of a toroidal fusion device.

27619 **Method of controlling fusion reaction rates.** Kulsrud, R.M.; Furth, H.P.; Valeo, E.J.; Goldhaber, M. (to Dept. of Energy). US Patent Application 6-492,924. 9 May 1983. 9p. Contract AC02-76CH03073.

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This invention relates to a method of controlling the reaction rates in a nuclear fusion reactor; and more particularly, to the use of polarized nuclear fuel.

27620 **Graphite-ceramic rf Faraday-thermal shield and plasma limiter.** Hwang, D.L.Q.; Hosea, J.C. (to Dept. of Energy). US Patent Application 6-491,639. 5 May 1983. 18p. Contract AC02-76CH03073.

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The present invention is directed to a brazing procedure for joining a ceramic or glass material (e.g., Al_2O_3 or Macor) to graphite. In particular, the present invention is directed to a novel brazing procedure for the production of a brazed ceramic graphite product useful as a Faraday shield. The brazed ceramic graphite Faraday shield of the present invention may be used in Magnetic Fusion Devices (e.g., Princeton Large Torus Tokamak) or other high temperature resistant apparatus.

27621 **On the energy and momentum deposition in the ion beam-pellet interaction.** Cuperman, S.; Levush, B. (Tel Aviv University, Department of Physics and Astronomy Ramat Aviv). *Nuclear Science and Engineering;* **81**: No. 1, 45-54(May 1982).

The ion beam-pellet interaction is investigated by using a time-dependent particle tracking algorithm for the slowing down of the bombarding ions. Model equations for energy and momentum deposition are developed and solved with the aid of a numerical code that describes the beam-pellet interaction as well as the subsequent heating and compression of the target. Results of calculations carried out for solid deuterium-tritium pellets using beams of deuterons, alpha particles, and lithium ions are presented and discussed. Two main conclusions are found to hold, namely: Consideration of the finite thermalization time of the ion in the transport process results in slower heating and compression of the pellet as well as in smaller thermonuclear yield ratios. Taking into account the momentum deposition of the bombarding ions in the pellet also provides different thermonuclear yields for low initial ion energies; for high initial ion energies, the effect of the momentum deposition is negligible.

27622 **Thermonuclear reactor materials. Chapter 6.** Gruen, D.M. (Argonne National Lab., IL (USA)). pp 313-366 of Materials science in energy technology. Sinfel't, D.; Simnad, M.; Khouv, D. . Moscow, USSR; Mir (1982). (In Russian)

Portions are illegible in microfiche products58 refs.; 1 fig.; 2 tabs.; translation from English.

Concept designs of thermonuclear reactors are briefly described and requirements placed upon structural materials of the first wall, insulators, diverter plates, blanket, superconducting magnets are formulated. Data on compatibility of materials perspective for application in thermonuclear reactors are presented and interaction of the materials with radiation is considered.

27623 **Comparison of one- and two-dimensional cross-section sensitivity calculations for a fusion reactor shielding experiment.** Seki, Y.; Lucius, J.L.; Oblow, E.M.; Santoro, R.T. (Oak Ridge National Laboratory, P.O. Box X Oak Ridge, Tennessee 37830). *Nuclear Science and Engineering;* **73**: No. 1, 87-93(Jan 1980). Contract W-7405-ENG-26.

Cross-section sensitivities calculated with one- and two-dimensional models of a fusion reactor shielding experiment are compared. The effectiveness of the two-dimensional calculation in accurately modeling the experiment and detector configurations is demonstrated. At the same time, the validity of a one-dimensional sensitivity study is also demonstrated.

99 GENERAL AND MISCELLANEOUS

9901 Management

REFER ALSO TO CITATION(S) 27639

27624 **(ANL—83-55) Chemical Technology Division. Annual technical report, 1982.** (Argonne National Lab., IL (USA)). Jul 1983. Contract W-31-109-ENG-38. 217p. NTIS, PC A10/MF A01. Order Number DE83017541.

Highlights of the Chemical Technology (CMT) Division's activities during 1982 are presented. In this period, CMT conducted research and development in the following areas: (1) advanced batteries, mainly lithium/iron sulfide, for electric-vehicle application; (2) aqueous batteries - improved lead-acid, nickel/zinc, and nickel/iron - for electric vehicles, as well as advanced lead-acid batteries for electric-utility load leveling; (3) advanced fuel cells (electrolytes of molten carbonate or solid oxide) for use by electric utilities; (4) coal technology, including fluidized-bed combustion of coal in the presence of an SO_2 sorbent of limestone and indirect liquefaction of coal with improved catalysts; (5) heat- and seed-recovery technology for open-cycle magnetohydrodynamic systems; (6) methodologies for utilization of energy from municipal waste; (7) solar energy collectors and thermal energy storage; (8) fuel cycle technology - nuclear waste management, proof-of-breeding for the light water breeder reactor, and sodium technology (e.g., cold traps) for liquid metal fast breeder reactors; and (9) magnetic fusion technology, mainly the breeder blanket. The Division also has a program in basic and applied materials research. Examples of this effort include experimental and theoretical studies on (1) the behavior of fission products likely to be released from light water reactor fuel under accident conditions; (2) the thermodynamic properties of a wide variety of inorganic materials; and (3) the transformation kinetics and formation mechanisms of atmospheric sulfate and nitrate aerosols. In addition, the Division continued to operate the central Analytical Chemistry Laboratory at Argonne. Separate abstracts were prepared for 12 sections of the report.

27625 **(DOE/ER—0191) Programs of the Office of Energy Research.** (USDOE Office of Energy Research, Washington, DC). Apr 1984. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011362.

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An overview is given for the DOE research programs in high energy and nuclear physics; fusion energy; basic energy sciences; health and environmental research; and advisory, assessment and support activities. (GHT)

27626 **(DOE/ER—0193) Health physics/radiation protection enrollments and degrees, 1983.** (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1984. Contract AC05-76OR00033. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010980.

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This report presents data on the number of students enrolled and the degrees awarded in academic year 1982-83 from 66 U.S. universities offering degree programs in radiation protection or related areas that would enable graduates to work as health physicists. The report includes historical survey data for the last decade and provides information about enrollment and degree trends, foreign national student participation, female and minority student participation, and placement of graduates. Also included is a listing of the universities by type of program and number of students.

27627 **(DOE/MA—0148) Collective bargaining agreement between Department of Energy Headquarters and the National Treasury Employees Union.** (National Treasury Employees Union, Washington, DC (USA)). Mar 1984. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010528.

This collective bargaining agreement is entered into to prescribe certain rights and obligations of the employees of the Department of Energy (DOE) Headquarters represented by the National Treasury Employees Union (NTEU) and to delineate procedures which are designed to meet the special requirements and needs of DOE Headquarters. The provisions of this agreement have been negotiated and should be interpreted in a manner consistent with the requirement of an effective and efficient Department.

27628 **(NSF—83-5) Annual science and technology report to the Congress: 1982.** (Office of Science and Technology Policy, Washington, DC (USA)). 3 Oct 1983. 120p. NTIS, PC A06/MF A01 - GPO* $5.00. Order Number DE84901150.

The science and technology policies in this report outline the framework in which the US Administration is addressing the challenges of maintaining the competitiveness of our industries in the international marketplace and ensuring the continued technological superiority of our defense capabilities. Chapters are included on decisions and actions in science and technology, outlook for selected fields of science, and federal research and development programs. (GHT)

27629 **(PNL-SA—12058) Development of a document preparation staff within an office automation environment.** Bebee, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 14p. (CONF-840276—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008649.

From 3. annual Office Systems Research conference; Los Angeles, CA, USA (18 Feb 1984).

Developing a document preparation staff in an office automation environment will not occur by accident. Office Automation will undoubtedly create job match challenges that management cannot ignore. For the implementation of Office Automation to be successful, one must look beyond the technology and understand the true basis for the success of any organization. As you adopt the belief that the people are the basis for the success of the organization, plan to do the following: develop job descriptions, build around the experienced staff, select staff by thorough evaluation, integrate new staff into the organization, provide planned staff growth and development, and have an ongoing staff development review process.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 25278, 25279, 25332, 25477, 27658, 27660, 27661, 27662, 27663, 27664, 27665, 27666, 27667, 27668, 27669, 27670, 27671, 27672, 27674, 27676, 27678, 27679, 27680, 27681, 27685, 27689, 27691, 27692, 27693, 27694, 27695, 27696, 27698, 27699, 27700, 27702, 27703, 27704, 27705, 27706

27630 **(BNL—34603) Limiting behavior of sample autocovariance function of a seasonal time series.** Tian, C.J. (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 11p. (CONF-8308167—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010792.

From 11. international time series meeting; Toronto, Canada (18 Aug 1983).

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In this paper we study a seasonal time series X/sub t/. Under some ergodic assumptions it is proved that the limit of sample autocovariance function of X/sub t/ exists and reveal same periodicity in some sense. Based on the limiting behavior, the problem of estimating period is also briefly discussed.

27631 **(LA—10049-M) User's guide for TWODANT: a code package for two-dimensional, diffusion-accelerated, neutral-particle transport.** Alcouffe, R.E.; Brinkley, F.W.; Marr, D.R.; O'Dell, R.D. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 40p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011011.

The TWODANT code package is a modular computer program designed to solve the two-dimensional, time-independent, multigroup discrete-ordinates form of the Boltzmann transport equation. TWODANT uses the same modular construction as the ONEDANT code. This modular construction separates the input processing, the transport equation solving, and the postprocessing, or edit functions, into distinct, independently executable code modules, the INPUT, SOLVER, and EDIT modules, respectively. These modules are connected to one another solely by means of binary interface files. The INPUT module and, to a lesser degree, the EDIT module are general in nature and are designed to be standardized modules. With these modules, different new production codes can be created simply by developing different SOLVER modules that can be plugged in to the standardized INPUT and EDIT modules.

27632 **(LBL—16254) Token ring local area networks. A comparison of experimental and theoretical performance.** Sventek, J.; Greiman, W.; O'Dell, M.; Jansen, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1983. Contract AC03-76SF00098. 17p. (CONF-831276—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010706.

From Computer networks symposium; Silver Spring, MD, USA (13 Dec 1983).

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Many existing performance models of local area networks are based on the assumptions of random traffic patterns and infinite buffer capacity. All real network implementations violate the infinite capacity assumption, while an inceasingly popular class of local area network applications violates the randomness assumption. This paper describes the experimental measurements of the characteristics of a commercially available token ring network. It is shown that the violation of both assumptions invalidates model predictions, and that the utility of all access control mechanisms for such applications must be reevaluated. Finally, it is shown that congestion is a very real problem even in small simple local area networks. Schemes for controlling interface congestion may require rather novel approaches to the problem.

27633 (LBL—16321, pp 404-413) **Performance prediction methods for evaluating PDE algorithms on MIMD machines.** Fok, S.K.; Wilson, J.R.; Heard, H.G.; Parker, J.A. (Tech. Development of California, Inc., Santa Clara). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper, a variety of current performance measures for SIMD machines are extended to MIMD machines. The concept of cost-effectiveness is elaborated and used to obtain an a posteriori estimate of the optimal number of processors to be used for a particular problem. Using both probability modeling and simulation, performance prediction methods are developed to evaluate the performance of the Large Eddy Code [7] of NASA-Ames on a tightly-coupled system such as the CRAY X-MP.

27634 **(N—83-24193) Overview of computer-based natural language processing.** Gevarter, W.B. (National Aeronautics and Space Administration, Washington, DC (USA). Office for Aeronautic and Space Technology). Apr 1983. 50p. (NASA-TM—85635; NBSIR—83-2687). NTIS, PC A03.

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Computer-based Natural Language-Processing (NLP) is the key to enabling humans and their computer-based creations to interact with machines in natural language (like English, Japanese, German, etc. in contrast to formal computer languages). The doors that such an achievement can open have made this a major research area in Artificial Intelligence and Computational Linguistics. Commercial natural language interfaces to computers have recently en-

tered the market and the future looks bright for other applications as well. This report reviews the basic approaches to such systems, the techniques utilized, applications, the state-of-the-art of the technology, issues and research requirements, the major participants, and finally, future trends and expectations. It is anticipated that this report will prove useful to engineering and research managers, potential users, and other who will be affected by this field as it unfolds.

27635 **(PB—83-217562) Overview of expert systems.** Gevarter, W.B. (National Bureau of Standards, Washington, DC (USA)). Oct 1982. 74p. (NBSIR—82-2505). NTIS, PC A04.

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This report provides an overview of Expert Systems - currently the hottest topic in the field of Artificial Intelligence. Topics covered include what it is, techniques used, existing systems, applications, who is doing it, who is funding it, the state-of-the-art, research requirements and future trends and opportunities.

27636 **(SAND—83-1670) Graphics Workstation Switching Unit.** Baldwin, D.B. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011626.

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The capability to operate a computer/aided design workstation from a number of different computer processor systems is required. In the past this was accomplished by separately recabling the terminal to another central processing unit (CPU). This report describes a Graphics Workstation Switching Unit that has been designed and built which eliminates the necessity to recable a terminal in order to connect it to another CPU. This unit is capable of switching 10 workstations between 2 CPUs.

27637 **(SAND—84-0281) SLATEC mathematical subprogram library, Version 2.0.** Vandevender, W.H. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010750.

The SLATEC Common Mathematical Subprogram Library is an experiment in resource sharing by the computing departments of several Department of Energy Laboratories. The objective is to cooperatively assemble and install at each site a mathematical subprogram library characterized by portability, good numerical technology, good documentation, robustness, and quality assurance. The result is a portable Fortran mathematical subprogram library of over 160,000 lines of code. Much of the following report is based on Reference 1, a chapter to be included in a forthcoming book about mathematical software.

27638 **(SAND—84-0447) Set covering, partition and packing.** Hulme, B.L.; Baca, L.S. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011171.

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Set covering problems are known to be solvable by Boolean algebraic methods. This report shows that set partition and set packing problems can be solved by the same algebraic methods because these problems can be converted into covering problems. Many applications are possible including security patrol assignment which is used as an example.

27639 **(SAND—84-0581C) DBMS conversion case study.** Dale, B.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 14p. (CONF-8405148—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011205.

From 2. annual DPMA software maintenance symposium; Washington, DC, USA (7 May 1984).

The Integrated Procurement System (IPS) is a very large data base application that supports purchasing, accounts payable and cost accounting for materials and services at Sandia National Laboratories. The system was the first data base application installed as a production system and has been around since the early 1970s. The size of the network data base is approximately 130 million characters and there are approximately 20 separate production jobs that run against it to perform various functions. In all, there are about 80 programs with a total of around 120,000 lines of COBOL source code. Several years ago, a redevelopment effort was launched to design and program a new Integrated Procurement System which would incorporate several features that were not available in the old version, including the capability to account for line item details on purchase orders and to perform our receiving function in an automated fashion rather than manually. It was also a goal to have all data input via screen programs, i.e., terminal input rather than keypunch and batched. The development of this conversion is described.

27640 **(SAND—84-0856C) ANVIL-4000 update.** Plomp, P.W. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 12p. (CONF-8405145—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84010602.

From IMOG/NSG meeting; Tampa, FL, USA (15 May 1984).

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The ANVIL-4000 interactive computer graphics software is used to program numerically controlled machine tools, construct accurate engineering drawings, and to solve geometric problems. Examples are cited demonstrating the use of the NC COMBO machining module.

27641 **(SAND—84-0919C) Common Data Input/Retrieval System.** Pate, J.E.; Muntz, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 17p. (CONF-8404136—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010972.

From USE conference; Dallas, TX, USA (2 Apr 1984).

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The Common Data Input/Retrieval System (CDIRS) is a generalized software system developed at Sandia National Laboratories which is incorporated into an application system to perform application data input and/or retrieval processing. The system operates in the on-line mode in the Transaction-Processing (TIP) environment, and in batch mode. The system may be used for retrieval and/or updating of both the transaction database and the application database. Features provided include data input/retrieval screens which are tailored to designer's specifications, access to transactions via six retrieval paths, backup and recoverability of transactions, and periodic archival of processed transactions. The system consists of 40 programs, of which 36 are written in Cobol and 4 are written in Assembler. Forty-three action codes are provided to accomplish various combinations of DMS activities. Security is available at three levels: datasystem-level, user-level, and transaction-level. The purpose of this paper is to provide an overview of the CDIRS environment from a user perspective. For this reason, some generalizations will be made, and some detail will be omitted. The system is complex, however; it will be necessary to provide enough detail to define the various entities, and attempt to explain how they interface.

27642 **(UCID—18852-Rev.2) Syntax and semantics of a LINCS control monologue.** Minton, J.A.; Donnelley, J.E.; Mecozzi, D.T.; Du Bois, P.J. (Lawrence Livermore National Lab., CA (USA)). 11 Apr 1984. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011399.

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The basic unit of information in a LINCS Control Monologue is a token. A sequence of tokens makes up a statement, a sequence of statements makes up a message, and one or more messages and associated state information make up a control monologue. A monologue is bound to an association. An association is made up of a speaker and a listener, where each is represented as a LINCS port address. The data structure in which the state informa-

tion retained is called a Control Monologue Record (CMR). This reference document defines the syntax and semantics of tokens, statements, messages, control monologues, and CMRs.

27643 **(UCID—30183-Rev.1) Linear systems analysis program. Programmer's manual, Version 2.2 (VAX/VMS).** Tilly, D.M. (Lawrence Livermore National Lab., CA (USA)). 20 Apr 1984. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010953.

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The computer program Linear Systems Analysis Program (LSAP) is an interactive program with graphics capability that can be used for the analysis and design of linear control systems. Nearly all classical design tools are available, including manipulation of transfer functions and generation of root locus, time response, and frequency response plots. This manual discusses the structure of the program. Included are explanations of implementation details of the underlying data structure.

27644 **(UCRL—83604-Rev.1) Serial link protocol design: a critique of the X.25 standard, Level 2.** Fletcher, J.G. (Lawrence Livermore National Lab., CA (USA)). 25 Oct 1983. Contract W-7405-ENG-48. 31p. (CONF-840636—Rev.1). NTIS, PC A03/MF A01. Order Number DE84002724.

From ACM SIGCOMM '84 symposium on communications architectures and protocols; Montreal, Canada (6 Jun 1984).

There are certain technical design principles for link communication protocols which, if followed, result in a protocol that is less complex in both concept and implementation, but at the same time provides better service, than if the principles are not followed. These principles include modularization into subprotocols, symmetry between the nodes on the link, and use of the state-exchange model of a conversation rather than the command-response model. The principles are described, the extent to which they are followed by the standard protocol X.25, level 2, is examined, and a protocol adhering to them is presented.

27645 **(UCRL—90351) Supercomputers: the next ten years - a user's view.** Ranelletti, J.E.; Michael, G.A. (Lawrence Livermore National Lab., CA (USA)). 6 Feb 1984. Contract W-7405-ENG-48. 6p. (CONF-8405147—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011072.

From 4. Jerusalem conference on information technology; Jersualem, Israel (26 May 1984).

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In a continuing effort to build faster computers, today's hardware architectural designers have turned to Multi-Instruction/Multi-Data machines (MIMDs) in order to achieve significant increases in capability. This paper represents the view of some potential users of such architectures. The authors call for consideration of a total Supercomputing Environment in order to meet the application needs of the future. Much research is needed soon in order to properly provide such a balanced environment.

27646 **(YALEU/DCS/RR—261) PLTMGC: a multi-grid continuation program for parameterized nonlinear elliptic systems.** Bank, R.E.; Chan, T.F. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Dec 1983. Contract AC02-81ER10996. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010406.

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PLTMGC is a program package for solving nonlinear elliptic systems that have explicit dependence on a scalar parameter. In addition to being able to compute solutions for fixed parameter values, it can be used to solve the linear eigenvalue problem, trace solution branches, accurately locate singular points (simple turning points and bifurcation points) and switch branch at simple bifurcation points. A multi-grid continuation approach is employed in which a continuation procedure is used to follow the solution curve on the coarsest grid and a multi-grid algorithm is used to refine the solution at selected points using an adaptive mesh refinement strategy. Some numerical examples illustrating the performance of the package are given.

27647 **(YALEU/DCS/RR—300) Approximate Newton method for coupled nonlinear systems.** Chan, T.F. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Feb 1984. Contract AC02-81ER10996. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010411.

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A general algorithm is proposed for solving a general class of coupled nonlinear systems. It is especially suitable for problems for which efficient solvers exist for part of the system but not for the whole. The algorithm can be applied in a modular fashion with calls to these solvers and fully exploits the efficiency built into them. The local convergence analysis shows that if the solvers are sufficiently contractive, then the algorithm converges locally.

27648 **(YALEU/DCS/TR—297) Techniques for large sparse systems arising from continuation methods.** Chan, T.F. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Dec 1983. Contract AC02-81ER10996. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010410.

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We survey numerical techniques for solving the nonlinear and linear systems arising from applying continuation methods to tracing solution manifolds of parameterized nonlinear systems of the form $G(u,\lambda) = 0$. We concentrate on large and sparse problems, e.g. discretizations of partial differential equations, for which this part of the computation dominates the overall cost. The basic issue is a tradeoff of the exploitation of the sparsity structure of the Jacobian G/sub u/ and the numerical treatment of its singularity. Among the techniques to be discussed are: Newton and quasi-Newton methods, low rank correction methods, implicit deflation techniques, Krylov subspace iterative methods and multi-grid methods.

27649 **Convergence of sequences of Pade approximants.** Baker, G.A. Jr.; Graves-Morris, P.R. (Los Alamos National Lab., NM). *Journal of Mathematical Analysis and Applications;* **87**: No. 2, 382-394(Jun 1982).

Criteria are specified for the selection of a convergent subsequence of Pade approximants out of a given sequence. Conditions which may be implemented computationally are given for establishing spherical equicontinuity of a sequence of Pade approximants, and these conditions suffice to prove spherical convergence.

9903 Information Handling

REFER ALSO TO CITATION(S) 26464

27650 **(AAEC/M—102) AAEC INIS online user manual.** Rugg, T.J.; Wong, S.C. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1983. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84700987.

The Australian Atomic Energy Commission's INIS database has been opened for online searching by non-AAEC personnel. System features and search commands are described.

27651 **(DOE/TIC—4585-R4) Energy Data Base corporate author entries.** Hendricks, P.L. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). Apr 1984. 860p. NTIS, PC A99/MF A01. Order Number DE84003877.

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The US Department of Energy is one of three agencies funding the major portion of government-supported research. One of the ways to locate the results of this research is to find reports in the Energy Data Base (EDB), the comprehensive data base of the Office of Scientific and Technical Information, Technical Information Center, and in publications derived therefrom by referring to the corporate organization performing the research. This information field has been established as an index point retrievable in online searching and is included as an index in printed publications. To provide consistent citing of names in bibliographic entries, this

authority has been created and maintained as a means of entry of corporate names into the EDB. To locate such information, one can (1) use the seven-digit code number assigned to the corporate entity of interest (enter, for example, IC=9506086) or (2) use one word at a time from the corporate name given (enter, for example, CS=Dominion).

27652 **(IAEA-INIS—11-Rev.12) INIS: authority list for journal titles.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1984. 288p. UNIPUB, PO Box 433, Murray Hill Station, New York, NY 10157.

This is the twelfth revision of the INIS: Authority List for Journal Titles (IAEA-INIS-11). It lists the titles of 8471 journals which have contained articles within the scope of INIS. The purpose of this report is to provide descriptive cataloguers with a standard abbreviation for journal titles and users of INIS products with a tool for verifying the full title of a journal. This bibliographic element (Tag 230, bibliographic level S) is discussed in INIS: Descriptive Cataloguing Rules (IAEA-INIS-1). The cataloguer should also be familiar with the correct method of giving the date (Tag 403) and the collation (Tag 500) for journal articles. In this report as well as in other INIS publications and forms, the term journal is used for publications of a periodical nature, including annuals such as Annual Review of Nuclear Science. It does not include publishers' series such as McGraw-Hill Series in Nuclear Engineering. If available, ISSN and CODEN are given. To facilitate input preparation one may enter either the abbreviated journal title at Tag 230, bibliographic level S, or the respective ISSN at Tag 230, bibliographic level S, or both. The elements not entered, the journal title abbreviation or the ISSN - whichever is applicable - will automatically be added during central processing.

27653 **(IAEA-INIS—17-Rev.2) INIS: manual for online retrieval.** Schiele, J.; Kurtev, I.; Ruckenbauer, E.; Stanik, Z.; Varecka, F.; Schmid, H. (International Atomic Energy Agency, Vienna (Austria)). Mar 1984. 144p. UNIPUB, PO Box 433, Murray Hill Station, New York, NY 10157.

This manual is addressed to users participating in the INIS Online Service available at the IAEA in Vienna. The retrieval system used at the IAEA is IBM/STAIRS (Storage and Information Retrieval System), installed on an IBM mainframe computer operating under OS/MVS and the TP monitor CICS. STAIRS is a multipurpose software package which enables the user to carry out retrieval on suitably structured textual and/or numerical data files in both interactive (i.e. online) and batch modes. In addition to the actual retrieval modules, the system also includes a number of auxiliary facilities which assist in the preparation and management of search files, help the users in printing the document references retrieved and in saving formulated queries for later execution or SDI processing, etc. Because of certain modifications and extensions made by the IAEA, the retrieval dialogue will be slightly different from the standard STAIRS. The present manual describes the INIS/STAIRS database and the IAEA/STAIRS retrieval language.

27654 **(LBL—14083) Enhancements to the codata data definition language.** McCarthy, J.L. (Lawrence Berkeley Lab., CA (USA)). Feb 1982. Contract AC03-76SF00098. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010579.

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This memo outlines a number of proposed enhancements to the current codata data definition language (DDL) for SEEDIS. At present, the codata DDL is used in data definition files (DDF's) to describe both fixed format, character-image codata files and binary format SEEDIS Compressed data files. The basic enhancement proposed here is that we make the process of adding and changing metadata definitions easier (and less hardwired) than it has been in the past. We also propose specific enhancements to facilitate handling 1980 Census Project data files, including multidimensional data elements, dimension descriptions, and differentiated labeling components.

27655 (LBL—16321, pp 2-8) **Data-bases for clinical histories.** Elliman, A.D. (Brunel Univ., Uxbridge, England). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

Medical researchers frequently investigate the progress of a disease or treatment by collecting a number of case histories. Data only becomes available when suitable patients present themselves and each patient may need to be followed for some years. A study of this type is a long term exercise. Such studies are only made possible by the availability of computers for data collection and analysis. Several data-base systems are available for clinical research, but many of these do not give enough attention to the dynamic aspects of this type of work. To identify the problem areas models for both the investigator's and patient's interaction with the data-base are presented.

27656 (LBL—16321, pp 9-18) **Features of a system for statistical databases.** Ozsoyoglu, G.; Ozsoyoglu, Z.M. (Case Western Reserve Univ., Cleveland, OH). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

Desirable features of statistical databases (SDB) are listed and the architecture and major features of a statistical database management system, called the System for Statistical Databases (SSDB), is summarized. SSDB uses a semantic data model designed to facilitate the data manipulation tasks of statistical database users. It incorporates tools to model operational populations such as experimental, cleaned, interpreted and representative populations, and has the capacity to model summary tables, histograms, matrices, crosstabulations, scatter diagrams and two-dimensional plots. The data model uses the compartmentalization concept to minimize the effects of SDB security enforcement. The SSDB software is partitioned into certified and uncertified modules, and the flow of control within SSDB is designed to allow SDB security checking at execution time. Finally SSDB has a screen-oriented query language to manipulate summary and raw data. The paper concludes with a brief overview of the existing and proposed systems.

27657 (LBL—16321, pp 19-21) **Issues related to medical statistical databases.** Long, J.M.; Brashear, J.R. (Univ. of Minnesota, Minneapolis). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The underlying system for most if not all medical statistical databases is the patient medical record whose automation is still in a development stage. The automation of this underlying system is not standardized and its standardization is the subject of debate. Ethical and legal considerations add to the difficulty in generating statistical databases containing medical data ragardless of its use in demographic, epidemiologic, or other research and planning applications. None of these problems appear to have short range solutions. To minimize the impact of these problems on statistical databases in support of planning and research needs, the structure and content of statistical databases using medical data can and should be kept as simple as possible.

27658 (LBL—16321, pp 32-38) **Model for a clinical research database.** Goldman, A.I. (Univ. of Minnesota, Minneapolis). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A model for the organization of a clinical research database is described. The model is based mainly on the Minnesota Bone Marrow Transplant and the Leukemia-Lymphoma Databases which are characterized by patient data with non-rectangular format, prospectively collected as patients are followed. The SIR data management system is used because of its flexibility and the ease with which statistical analysis files can be created. A main focus of the file organization is an emphasis on events rather than lab values as endpoints. Records for patients, event labels, and protocol are separate case types and linked together during retrieval.

27659 (LBL—16321, pp 39-45) **Research needs and database development: push and pull.** Meierhoefer, B.S. (Federal Judicial Center, Washington, DC). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper traces the inception of a database reorganization project that got its stimulus from a research question. When asked to look into what constitutes an overburdened court in terms of per judge caseload, researchers at the Federal Judicial Center developed a research design calling for relatively sophisticated time series and survival analyses involving large amounts of data over a ten year period. Though the necessary data were available from the administrative agency which prepares annual statistical reports for the federal court system, they were not organized in a way to permit the case tracking analyses called for by the research design. As a result, the Center is now in the process of developing a research oriented database which will integrate pertinent federal court case data from 1970 through 1982 and be updated as new information becomes available.

27660 (LBL—16321, pp 54-63) **Multi-tree automation for efficient data transmission.** Hazboun, K.A.; Raymond, J.L. (Pennsylvania State Univ., University Park). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A two-stage finite state implementation of an efficient compression algorithm is outlined. This designs proposed for the economic transmission of large volume of data within a distributed network of statistical databases. The encoder/decoder stage of the design is based on a reversible semantic-independent variable-length character technique that makes use of the group locality of character reference behavior and the variable frequency of character occurrence within a well-defined subgroupings of the character set. The two-stage automata, while specifically designed for a modified version of the Hazboun-Bassiouni Multi-Group algorithm, is extended to support any single character look-ahead procedure.

27661 (LBL—16321, pp 64-72) **Relational database machine for efficient processing of statistical queries.** Farsi, H.; Tartar, J. (Univ. of Alberta, Edmonton). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper presents the design of a data base machine for supporting statistical data bases. The primary objective of this research is to introduce an architecture which performs efficiently in executing relational operations on fully transposed files. This objective is met by utilization of two functionally specialized subsystems: category and summary subsystems. The category subsystem exploits the parallel, content addressed search capabilities of associative memories (AM) while the summary subsystem employs a set of functionally equivalent processors suitable for evaluating statistical functions. In order to support processing of category attributes, the design of an extended associative memory has been considered and its features are presented. The most important feature of this AM stems from its ability to sort selected tuples of a relation, with respect to several attributes simultaneously and at the same time to produce an inverted list for each attribute. Sorting is performed by enumeration. The sorted inverted lists are used for efficient execution of relational projection and join operations.

27662 (LBL—16321, pp 73-79) **SIBYL: an economist's workbench.** Heiler, S.I.; Bergman, R.F. (World Bank, Washington, DC). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper presents a report on work in progress on the development of the SIBYL system, an economist's workbench at the World Bank. The principle objectives are to provide capabilities for sharing data among a large and diverse user community, handling a growing number of databases, and providing access to a collection of analytical and modeling packages. The implementations oriented towards using off-the-shelf software, a large mainframe with Model 204 DBMS to handle the databases, and a group of microcomputers running UNIX. The key components integrating this architecture are a database template, a set of generalized procedures for browsing, updating and extracting data, and translators between the databases and the analytical and reportwriting packages. The project has been in progress since May 1982 and a prototype system is installed for three user groups. It will continue to evolve over the next year with additional development focused on providing a batch update facility, writing validation procedures, refining the user interface, and establishing a local network.

27663 (LBL—16321, pp 89-94) **Data management without a database manager.** Fox, M.A. (Univ. of California, Los Angeles). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A file-handling full screen data entry, verification, updating, and displays system, with overtones of a data base management system without the overhead is described. Using a high level specification language, created automatically by describing a form on the screen, a PL/1 program is generated which will display empty forms allowing data entry, verification and retrieval (by example). Files or transactions to data base systems may be constructed, and existing files formatted for display, post hoc field validation and restructuring. The system is complete but may be interfaced with other systems and, because it is a program generator, used to provide building blocks (reuseable code) for other full screen applications.

27664 (LBL—16321, pp 99-103) **Distributed data management in a minicomputer network: the SEEDIS experience.** Merrill, D.; McCarthy, J.; Gey, F.; Holmes, H. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A19/MF A01. (CONF-830950—). Contract AC03-76SF00098.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper described distributed data management aspects of SEEDIS (Socio-Economic Environmental Demographic Information System). SEEDIS is an experimental system for the retrieval, analysis, and display of geographically linked data. SEEDIS operates on nine computers in a nationwide network. Users at any location select and retrieve all data in the same way, regardless of whether they are stored locally or at a remote location. The network implementation has been substantially modified during 1983. New enhancements include: local caching of data files to improve efficiency; linking to an automatic tape library (ATL) to make larger volumes of data accessible; node independence to facilitate automatic sharing of data among autonomous SEEDIS installations without the need for central control; improvements providing robust operation despite unreliable network connections; and automatic recording of all cache transactions for subsequent statistical analysis.

27665 (LBL—16321, pp 104-110) **Integrated research support system for inter-package communication and handling large volume output from statistical database analysis operations.** Anderson, G.D.; Snider, T.; Toporek, J. (McMaster Univ., Hamilton, Ontario). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes work underway to develop an integrated research support system designed to link together into a unified system a generalized DBMS, a relational database query system, statistical packages, a graphics system, text editors and a generalized screen oriented output handler. The work is being carried out on the Hewlett Packard HP9000 32 bit micro computer system under HP-UX; HP's implementation of the UNIX/sup TM/ operating system. The intent of the project is to provide a unified environment designed specifically for the researcher.

27666 (LBL—16321, pp 111-118) **Integrating data and documentation in a multi-national research project: the IEA second international mathematics study.** Wolfe, R.G. (Ontario Inst. for Studies in Education, Toronto). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

With recent advances in the design of statistical software systems, data files with a hierarchy of observations can be stored

with appropriate linkage of data and documentation and analytically aggregated and disaggregated. However, additional layers of organizational complexity need to be incorporated into the design of statistical databases when it is desired to integrate research studies that are parallel in sampling and instrumentation, but not identical. This occurs when a research survey is repeated over several years or in several countries. Integration may be facilitated with a central documentation file of tables and text that capture inter-study variation and can drive analysis programs. This is illustrated in an application to a 20-country set of school mathematics surveys.

27667 (LBL—16321, pp 119-123) **PASTE: a tool to put application systems together easily.** Weiss, S.E.; Weeks, P.L. (Bureau of Labor Statistics, Washington, DC). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The collections of statistical packages, tabulation systems, and database systems that have grown up in the past 10 years constitute a significant advance in the tools available to the statistician. Unfortunately, each of these tools is limited. The developer of an application system using these tools is often faced with the difficult problem of stringing these systems together to get a complete application system. Two approaches have been applied to alleviating this problem. Arguments are advanced against each of these approaches. A new solution to the problem is proposed. The solution is a system called PASTE whose purpose is to Put Application Systems Together Easily. A preliminary design of this highly flexible and extensible data description and file transformation system is described.

27668 (LBL—16321, pp 124-132) **Interactive statistical database management system.** Wartelle, M.; Kramar, A.; Jan, P.; Kruger, D. (Inst. GUSTAVE ROUSSY, Villejuif, France). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

PIGAS is an interactive statistical database management system whose main assets include logical data checking, data entry for meaningful variables only, three different types of missing value codes, non-rectangular data structure and user interfaces with BMDP, GLIM or specifically written FORTRAN programs. The structure of the PIGAS language is the same as one passes from one phase of a research study to another, whether it be data updating, checking or analysis, thus requiring only a minimum amount of initiation in its use. It is particularly appealing since data verification is completely specified through variable names as they appear on the questionnaire. Instructions given in how to fill in a questionnaire can thus be directly incorporated in the data checking process, thus ensuring a good quality data base.

27669 (LBL—16321, pp 133-142) **Simulators, statistical analysis, and databases.** Scuse, D.H.; Arnason, A.N. (Univ. of Manitoba, Winnepeg). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper described advantages of integrating simulators, statistical analysis programs, and databases in a common statistical information system. It has been found that the integration of the components in a statistical information system greatly enhances the value of the individual components, makes the resulting system easier to use by end-users, and reduces the amount of work required to implement new applications and modify existing applications.

27670 (LBL—16321, pp 144-147) **CANSIM, the Canadian socio-economic management information system.** Podehl, M. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

CANSIM, the Canadian Socio-Economic Information Management system is Statistics Canada's computerized data bank and information retrievel service. This paper gives an overview of the current status and development activities of electronic information services provided by Statistics Canada.

27671 (LBL—16321, pp 148-151) **Diversification in statistical data bases.** Poot, H.C. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this brief report the author discusses the consequences of growth and diversification in statistical data bases as evidenced at Data Resources, Inc. (DRI). In general, one sees time-series being used in closer conjunction with cross-sectional and textural information. This has a great impact on the types of software used. The variety of data available requires more diverse methods of quality control. The amount and scope of information now online requires that descriptive and reference materials be made available online, particularly in the area of current awareness.

27672 (LBL—16321, pp 152-153) **Econometric time series on DIALOG.** Lundy, R.T. (DIALOG Information Services, Palo Alto, CA). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

DIALOG Information Services, Inc., the leading commerical provider of online non-numeric database services, has also been involved in the development of numeric databases, particularly time series. This report described the efforts being made to adapt an essentially test-oriented retrieval system to the needs of users of econometric time series.

27673 (LBL—16321, pp 154-156) **Evolution in storage and retrieval: the LABSTAT data base and software system.** Harllee, G.L. (Bureau of Labor Statistics, Washington, DC). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The use of an integrated data bank for time series data was initially introduced at the Bureau of Labor Statistics two decades ago. The data bank has been available on line since LABSTAT was introduced in 1977. This paper summarizes some of the major developments in the data bank and access software and discusses some enhancements currently being considered.

27674 (LBL—16321, pp 157-166) **Interactive information management with EPS.** Childs, S.R. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper provides an illustration of interactive statistical data base management. Its focus is on the use of the EPS (Econometric Programming System) software language as a manager of information. EPS is usually employed to analyze time series information using econometric techniques. The paper will illustrate some EPS capabilities using several data bases developed by Gnostic Concepts, Inc., a subsidiary of DRI (Data Resources, Inc.) specializing in market analysis of the electronics industry.

27675 (LBL—16321, pp 167-169) **Meta data: an experience of its uses and management.** Cubitt, R.E. (Statistical Office of the European Communities, Luxembourg). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This short paper presents some of the problems surrounding the management and use of the meta data which is associated with most types of statistical data. Current approaches to the problems which are being taken within the Statistical Office of the EC are described.

27676 (LBL—16321, pp 170-171) **Problems, plans and activities concerning the economic databases at Statistics Sweden.** Nordbaeck, L. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper some of the issues concerning the move towards the terminalized dissemination of statistics from a central sta-

tistical office will be highlighted: the implications of the new techniques on the in-house activities; the way to assimilate this new technique into the different statistics consumers' hardware and software environment; and the problems to suite different levels of knowledge of data processing in the man-machine interface.

27677 (LBL—16321, pp 172) **Proposal for workshop on large economic data bases.** Levioff, P. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

Outline for discussion purposes concerning problems confronting data base managers in their role as conduits between data sources and end users.

27678 (LBL—16321, pp 173-177) **SAS applied to statistical databanks via a command language.** Nilsson, I. (I/S Datacentralen af 1959, Copenhagen, Denmark). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes how a command language, DC-TIME Series Management System, is used as an interface between the user, a databank and SAS, Statistical Analysis System. The aim is to give easy access to time series in a large databank to a great variety of users ranging from those just in need for the data to the ones requiring an analysis tool like SAS. The paper gives an account of the structure of DC-TIME, which is actually a combination of a command language and a dialogue. To illustrate the application and the usefulness of the system some examples are given using the databank CRONOS-Eurostat, which contains macro-economic time series concerning national accounts, production, trade, etc., for a large number of countries. Various ways of presenting the data, using the facilities in SAS, are also given.

27679 (LBL—16321, pp 178-187) **Statistical data manipulation language.** Barsottini, G.; Farget, J.C. (Systems and Management, Torino, Italy). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A new Data Model based on a set theoretic approach is proposed here; it is intended to fit the statistician requirements by giving them the ability to describe data in terms of classes of objects which are ordered according to users needs. Classes are identified by the handle which is a set of attributes; they are gathered in collections. Based on that Model a Statistical Data Manipulation Language (SDML) is presented to provide tools for Statistical Manipulations on Collections. Basic classes of operations are Retrieve, partition, internal or inter-object operations and join of collections. The SDML has been designed to be concise, user-friendly and extensible.

27680 (LBL—16321, pp 188-195) **Complex data types and a data manipulation language for scientific and statistical databases.** Brown, V.A.; Navathe, S.B.; Su, S.Y.W. (Univ. of Florida, Gainesville). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A Scientific and Statistical DBMS needs to recognize a greater variety of data types than those currently supported by conventional DBMSs. Using the concept of abstract data types, a set of extended data types (Complex Data Types) is proposed to be supported directly by the DBMS. The Complex Data Types presently recongized include: set, vector, ordered set, matrix, time, time series, text, and generalized relation. A data manipulation language designed specifically for scientific and statistical data processing is presented using these types as a basis.

27681 (LBL—16321, pp 196-201) **Data structures for scientific simulation programs.** Bell, J. (Univ. of Colorado, Boulder). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This research investigates data management, data structures, and constraints on data structure design in a cross section of programs known as "scientific models". Scientific models are large programs that use numerical approximation techniques to simulate physical phenomena for which exact solution is impossible, e.g. weather forecasting models. Scientific models, as a class, use remarkably similar data structures. The generic structures and access patterns in scientific models are the basis for functional specification of a data management system tailored to this application class.

27682 (LBL—16321, pp 202-211) **Extension of relational algebra for summary tables.** Ozsoyoglu, Z.M.; Ozsoyoglu, G. (Case Western Reserve Univ., Cleveland, OH). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A summary table is one of the useful data structures used in statistical databases. For an algebraic summary table manipulation language, the authors first extend relational algebra for nested relations and aggregate functions, then propose a summary table manipulation language based on the extended algebra. A new operator, called aggregation-by-template is introduced, and other operators of the relational algebra are modified to apply nested relations. A special case of summary tables, called primitive summary table, is distinguished since it can be directly represented by a nested relation. Primitive summary tables are viewed as building blocks of summary tables. Operators for constructing and manipulating summary tables, and their properties are also discussed.

27683 (LBL—16321, pp 212-219) **How baroque should a statistical database management system be?.** Olken, F. (Univ. of California, Berkeley). 1983. NTIS, PC A19/MF A01. (CONF-830950—). Contract AC03-76SF00098.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

How elaborate should the functionality, data types, and data models of a statistical database management system be? In this paper several criteria to be used in deciding the matter are considered: efficiency, data semantics, standardization, integrity, security, and useability. On the basis of these criteria the authors construct a taxonomy of proposals for enhanced functionality of statistical database management systems.

27684 (LBL—16321, pp 220-222) **How far should a database system go? (to support a statistical one).** Swartwout, D. (Bell Laboratories, Murray Hill, NJ). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This note discusses some issues that were addressed in adapting a prototype database management system to enable it to supply data to a statistical system. The issues include the choice of statistically-oriented features for the database system, the "right" way to do aggregate computations, and some side effects of decisions that were made in this case.

27685 (LBL—16321, pp 223-229) **Integrated macro-economic data management system based on multi-dimensional arrays.** Gibbons, M.; David, M. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The paper describes the system currently being developed at the OECD for the management of macro-economic data. The system provides a general framework for economists and statisticians to structure and manipulate large volumes of data in the form of multi-dimensional arrays. The dimensions of the arrays are hierarchical lists of elements corresponding to criteria of classification, TIME typically being one of them. Derivation of data can occur either automatically during extraction or explicitly through a flexible Data Manipulation Language. The system fully incorporates the management of qualitative information associated with the data at several levels. A number of interfaces are provided including an extension to the Research and Analysis Language (RAL).

27686 (LBL—16321, pp 230-234) **Classification of metadata.** Bishop, Y.M.; Freedman, S.R. (Dept. of Energy, Washington, DC). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The Energy Information Administration (EIA) has developed a search tool, the Data Resources Directory, that tracks the energy information obtained on source data collection forms to its final publication. The metadata is indexed according to a specially developed hierarchical classification scheme. Experience so far has indicated good features of this approach but problems still remain to be solved, particularly in determining optimum classification strategies for metadata.

27687 (LBL—16321, pp 235-244) **Some experiments in evaluation of an expert system for statistical estimation on databases.** Rowe, N.C. (Stanford Univ., CA). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper for the first of these Workshops advantages of a new approach to estimation of statistics on databases are claimed. These claims are now backed up with quantitative experimental evidence of the comparative performance of this approach versus several simpler alternatives.

27688 (LBL—16321, pp 245-250) **GENISYS data definition facilities.** Maness, A.T.; Dintelman, S.M. (Univ. of Utah, Salt Lake City). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper briefly describes the data definition facilities of the Genealogical Information System, GENISYS, which include the ability to define and to modify the definitions of the various database elements such as files, fields, logical links between files and forms to input, display and modify data. The use of a source definition and a target definition for data translation is presented. Also included is a list of proposed improvements and extensions to the current facilities.

27689 (LBL—16321, pp 251-263) **Logical and physical modeling of statistical/scientific databases.** Su, S.Y.W.; Navathe, S.B.; Batory, D.S. (Univ. of Florida, Gainesville). 1983. NTIS, PC A19/MF A01. (CONF-830950—). Contract AS05-81ER10977.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes the major research tasks currently being undertaken at the Database System Research and Development Center at the University of Florida in the area of management of statistical databases. It presents the progress made to data and accomplishments related to the following: 1) the development of a semantic association model and its data language for use in statistical/scientific applications, 2) the study of a data mapping between (a) semantic model and the model used by a particular DBMS and between a logical model and its physical implementation, and (b) view integration problems in database design, 3) the investigation of data compression techniques and the development of a general model of database implementation, and 4) the study of parallel algorithms and database machine techniques for the efficient processing of statistical/scientific databases. The research project has been supported by the Applied Mathematical Science Program of the Department of Energy under contract # DE-AS05-81ER10977.

27690 (LBL—16321, pp 264-272) **Proposal of a logical model for statistical data base.** Rafanelli, M.; Ricci, F.L. (Ist. Analisi dei Sistemi ed Informatica, Roma, Italy). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper the authors propose a logical model (called GRASS) for representing both the properties of a Statistical Data Base (S.D.B.) and the tables view, which represent the peculiar reality of statistical user. The proposed model consists of a marked, labeled, direct, connected, acyclic, partially ordered graph. For this graph nodes semantics and connection and branching rules are provided. A cognitive and selective approach on how to navigate through category attributes and summary data are given, too. Finally, some facilities of the model are discussed and a comment is made.

27691 (LBL—16321, pp 273-279) **Statistical data management research at Lawrence Berkeley Laboratory.** Chan, P.; Eggers, S.; Gey, F.; Holmes, H.; Kreps, P.; McCarthy, J.; Merrill, D.; Olken, F.; Shoshani, A.; Wong, H. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A19/MF A01. (CONF-830950—). Contract AC03-76SF00098.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper summarizes current research on statistical database management issues at the Lawrence Berkeley Laboratory. This research included development of prototype systems as well as analytic work on user interfaces, physical organization, hardware architecture, and database modeling.

27692 (LBL—16321, pp 280-286) **Statistical database component of a data analysis and modelling system: lessons from eight years of user experience.** Klensin, J.C. (Massachusetts Inst. of Tech., Cambridge). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

When development of the Consistent System, a large-scale data analysis and modelling system for the social, policy, and behavioral sciences, began, it was determined that database management facilities would be necessary to handle the variety of complex data that were anticipated. The primary data base management component of that system, called Janus, has been in use, in two prototypes and then in production form, at several sites and by a variety of users, since about 1975. This paper reviews some of the original design considerations about Janus (including its relationship to the rest of the Consistent System) and reflects on them in light of user experiences and comments in the subsequent years.

27693 (LBL—16321, pp 287-295) **System/K: a knowledge base management system.** Maier, M.; Cirilli, C. (IBM Scientific Center, Pisa, Italy). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

System/K is a Knowledge Base Management System designed to offer a set of facilities for knowledge representation and usage at the conceptual level by means of three descriptive mechanisms ("Aggregate", "Derive" and "Collect"). Two specific object-types (Assertions and Sets) are defined to represent the "part-off", "is-a" and "member-of" relationships. An "object-oriented" cross-reference logic is defined, that saves users from having to be constantly aware of "keys". System/K refers to SQL/DS (a relational DBMS) to maintain information concerning both the conceptual relationships (meta-database) and the description of the entities in the real world (database). A logic is defined to generate the appropriate relation schemes starting from the conceptual definitions.

27694 (LBL—16321, pp 296-305) **Computer-independent data compression for large statistical databases.** Gey, F.; McCarthy, J.L.; Merrill, D.; Holmes, H. (Lawrence Berkeley Lab., CA). 1983. NTIS, PC A19/MF A01. (CONF-830950—). Contract AC03-76SF00098.

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes a dictionary-driven, hardware-independent data compression scheme for archival storage of large statistical databases. It discusses motivations for this development, storage format requirements, implementation details, access considerations, and possible extensions of the technique. It also analyzes the degree of compression achieved for different types of statistical data files.

27695 (LBL—16321, pp 306-314) **Index coding: a compression technique for large statistical databases.** Batory, D.S. (Univ. of Florida, Gainesville). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

Index encoding is a compression technique that involves the substitution of numeric codes for data values. Current methods of index encoding are suited only for attributes whose underlying domains are small or static. In this paper, general methods to encode dynamic domains are proposed and analyzed. A practical methodology for their application is presented. The authors also compare and contrast our methods with another that is now being used in a commercial file management system.

27696 (LBL—16321, pp 315-324) **Overview of cantor: a new system for data analysis.** Karasalo, I.; Svensson, P. (Swedish National Defense Research Inst., Stockholm). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A transportable system for the analysis of large sets of data, forming complex information structures, is being developed at the Swedish National Defense Research Institute, with financial support also from some civilian Swedish government agencies. The system is based on a relational data base handler of new design, permitting efficient data storage and fast evaluation of complex, spontaneous queries. A query language, based on set algebra and oriented towards scientist users, was developed for the system. To this kernel will be added subsystems for interactive sublanguage definition and user communication, data loading, tabular and graphic data presentation, statistical analyses, and data base backup and recovery. The paper presents an overview of the system version now completed.

27697 (LBL—16321, pp 325-330) **Statistical database research project in Japan and the CAS SDB project.** Shibano, K.; Sato, H. (Tokyo Scientific Center, Japan). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper, a description is given of working statistical database systems in Japan. Most are special purpose systems. In 1983, a comprehensive statistical database research project MUSE began in academic societies. In conjunction with it, EPA is going on an SDB development project (CAS SDB project). CAS SDB plans to handle a large amount of statistical summary data and to support a variety of social scientific uses. Statistical meta-data problems and a current design for a statistical meta database are discussed. A current implementation of CAS SDB is also described. It was implemented on a relational DBMS and has an interface with SAS. The capabilities of CAS SDB in real statistical applications are now being tested.

27698 (LBL—16321, pp 331-337) **Strategy for implementing a computer efficient database management system preliminary research report.** Dixie, J.; Wake, P. (Office of Population Censuses and Surveys, Titchfield, England). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

The United Kingdom census office has a need to improve access to large data sets such as the population census, registrations of births, marriages, deaths and diseases, and major social surveys. In general terms the need is to access a small number of data fields from a large number of records (with or without filtering) for applications in which the data volume is enormous but stable (say 100Mb or greater). A DBMS with transposed file structure (like RAPID) would appear to be ideal for this. A strategy is proposed for implementing such a system on ICL 2900 range computers. Questions are raised concerning enhanceability, programming languages, data packing and file structure, storage of meta-data, and the use of the operating system. A recently implemented secondary (macro) data TDF (Transposed Datastore File) is described and the possibility of using the same structure for primary (micro) data is discussed.

27699 (LBL—16321, pp 338-345) **Utilization of character reference locality for efficient storage of data base.** Bassiouni, M.A.; Hazboun, K.A. (Univ. of Central Florida, Tampa). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper describes an efficient character encoding method based on practically observed properties of character occurences within files. The method is specially designed for the encoding of files containing both numeric and alphabetic fields. It is therefore particularly attractive for the storage of many large database files, encountered in practice, which are amenable to statistical analysis. The technique of using m-grams is also incorporated to enhance the compression efficiency. Numerical tests have given favorable results for the proposed method.

27700 (LBL—16321, pp 346-354) **Automated cell suppression to preserve confidentiality of business statistics.** Sande, G. (Statistics Canada, Ottawa, Ontario). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A Statistical Agency must balance the competing requirements of preserving the confidentiality of the data obtained from respondents and of publishing statistical summaries of the data obtained from respondents. This note will describe the components of an experimental suite of software which seeks to resolve this conflict in the case of economic censuses. The components described will be those which identify sensitive statistics, determine complementary suppressions and audit the suppressed publications. These components are supported by an infrastructure of utility programmes. Experience with the software on various economic censuses and opportunities for further work will be discussed.

27701 (LBL—16321, pp 355-359) **Information theoretic approach to statistical databases and their security: a preliminary report.** McLeish, M. (Univ. of Guelph, Ontario). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper considers a statistical database model used by J. Kam and J. Ullman in [5] to study database security. Results for the transmitter-receiver problem studied in information theory are applied to the database model to provide a measure of the information in the query-record system. A slightly different information theoretic approach is then used to provide a more effective model for the security problem. Results are obtained which give the conditions on queries necessary to minimize the information gained by making a security breach. Statistical methods can then be used to determine if a series of queries are being used which have properties significantly close to those required to endanger the security.

27702 (LBL—16321, pp 360-367) **Introduction to sampling to estimate database integrity.** Greer, R. (Bell Labs., Murray Hill, NJ). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In order to create a sound and meaningful sampling plan for estimating measures of database integrity, a statistician must first have appropriate theoretical tools for understanding the nature of databases and their integrity constraints, for developing reasonable numerical measures of database integrity, and for determining the sampling unit and its relationship to the integrity measures. This paper uses database theory, mathematical logic, and sampling theory to provide such tools.

27703 (LBL—16321, pp 368-390) **Security model for the statistical database problem.** Denning, D.E. (Purdue Univ., West Lafayette, IN). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

A security model for addressing the statistical inference problem in online query processing systems is described. The set of all statistics computed over groups of records having common

characteristics are structured as a lattice of logical tables. The lattice model provides a mathematical basis for studying the inference problem, and a framework for evaluating and comparing different controls. Although the lattice model has been used by census agencies to protect statistical tables published offline, it has only recently been used to develop inference controls for general purpose query processing systems.

27704 (LBL—16321, pp 391-403) **Statistical databases: their model, query language and security.** Michalewicz, Z. (Victoria Univeristy of Wellington, New Zealand). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

In this paper the problem of security of statistical databases, i.e., file systems, is dealt with. A model is proposed of a statistical database in which to investigate the properties of statistical databases and a query language connected with such a database is described. The problem of dependencies between attributes is discussed and the case when database contains incomplete information is considered. In the case of incomplete information the problems arrive with the interpretation of the query language, mainly for statistical terms. The need for a precise semantic is here evident.

27705 (LBL—16321, pp 414-423) **Using statistical software with a database management data theory.** Muller, R.J. 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This paper analyzes several statistical computing environments in an effort to show the relationship between formal database management theory and the computational environment as an integral part of data analysis. The paper uses Entity-Relationship theory as a data theory to compare the flexibility, representation, and problem-solving difficulties of the analyst in the Minitab, BMDP, SPSS, SAS, OSIRIS, SIR, and the Consistent/System computing environments. It shows that none make full use of database management capabilities; it also shows that even those capabilities are not capable of dealing with all problems confronting the statistically oriented data analyst.

27706 (LBL—16321, pp 95-98) **Development implications of an interactive, portable, user-friendly, statistical database management system.** Schiff, G.L. (Hoffmann-La Roche Inc., Nutley, NJ). 1983. NTIS, PC A19/MF A01. (CONF-830950—).

From 2. international statistical database management workshop; Los Altos, CA, USA (27 Sep 1983).

This is a definition of terms and discussion of the design and development of an interactive, portable, user-friendly statistical database management system from the perspective of a computer scientist. The definitions are fairly clear and can be found in most textbooks but their interactions, particularly when a system is being designed and developed which attempts to include all of them, have been given relatively little attention. This paper will focus on how the major structural elements of an "ideal" statistical database management system impinge on each other during the design and development phases of that system. There will also be a discussion of how these elements and their interactions affect the people designing, writing and using the system.

27707 **(SAND—84-0183C) Few results in message authentication.** Brickell, E.F. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 16p. (CONF-840282—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010975.

From 15. southeastern conference on combinatorics, graph theory and computing; Baton Rouge, LA, USA (5 Feb 1984).

Portions are illegible in microfiche products.

We prove a few inequalities about authentication systems and then define doubly perfect systems to be systems where equality holds. We show that orthogonal arrays or orthogonal multi-arrays can be used to construct doubly perfect systems.

27708 **Unique ORNL facilities used by academic and industrial scientists.** *Oak Ridge National Laboratory Review (United States);* **16**: No. 4, 58-59(Fal 1983).

Besides technology transfer to industry, ORNL also encourages the exchange of information between its researchers and those who work in the laboratories of industry and academia. Examples of ORNL-university and ORNL-industry interactions are briefly discussed.

27709 **Technical oral presentations: what happens to them?.** Lyon, W.S.; Roberts, P.P. (Oak Ridge National Lab., TN). *Analytical Proceedings (London);* **20**: 374-376(Jul 1983). Contract W-7405-ENG-26.

Technical oral presentations were reviewed in order to determine what fraction of them represented research as opposed to reviews. Efforts were made to determine what portion of these talks actually reached archival literature. A total of 380 oral presentations during the period 1977-1981 were studied. Results revealed that about one-third of these presentations never reached archival literature. These results were compared with those obtained from an actual conference. It was found that the ratio of research to review papers was somewhat higher at the conference, with the fraction attaining final publication being somewhat lower.

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Qualifier
Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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AC01-79CS30003	**McGraw-Hill Information Systems, Silver Spring, MD (USA)**	
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AC01-80CS30396	**Orkand Corp., Silver Spring, MD (USA)**	
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AC01-82CE15095	**National Center for Appropriate Technology, Butte, MT (USA)**	
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AC02-79ET34019	**Babcock and Wilcox Co., Lynchburg, VA (USA)**	
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AI01-76PR06010	**National Bureau of Standards, Washington, DC (USA)**	
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AI01-77CS51044	**Dayton Univ., OH (USA). Dept. of Electric Engineering**	
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	Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.-Electrical and Electronic Research	
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AI01-77ET20342	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
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	9:25745	JHU/APL-OQR—81-4
AI01-77ET20396	**Hydronautics, Inc., Laurel, MD (USA)**	
	9:25746	PB—83-221093
	Noda (E.K.) and Associates, Honolulu, HI (USA)	
	9:25747	PB—83-221143
	Science Applications, Inc., El Segundo, CA (USA)	
	9:25748	PB—83-221176
	Science Applications, Inc., La Jolla, CA (USA)	
	9:25749	PB—83-221184
	Hawaiian Dredging and Construction Co., Honolulu (USA)	
	9:25750	PB—83-221309
	Busby (R. Frank) Associates, Arlington, VA (USA)	
	9:25751	PB—83-221374
	Brown and Root Development, Inc., Houston, TX (USA)	
	9:25752	PB—83-221853
	Science Applications, Inc., El Segundo, CA (USA)	
	9:25753	PB—83-221945
	TRW Systems and Energy, Redondo Beach, CA (USA)	
	9:25754	PB—83-222059
	Norske Veritas, Oslo (Norway). Industrial and Offshore Div.	
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AI01-79CS50104	**American Electric Power Service Corp., New York**	
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AI01-79EV10103	**Lovelace Inhalation Toxicology Research Inst., Albuquerque, NM**	
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AI02-80RA50164	**Naval Civil Engineering Lab., Port Hueneme, CA (USA)**	
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AI05-83OR21363	**Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources**	
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AI08-78ET44802	**Geological Survey, Menlo Park, CA (USA)**	
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AI08-79DP40092	**Naval Research Lab., Washington, DC (USA)**	
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AM03-76SF00034	**Univ. of North Carolina, Chapel Hill**	
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AM04-80AL13137	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AM06-70RL02227	**Kernforschungsanlage, Juelich, West Germany**	
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AS03-76ET28484	**Geothermal Resources Council, Davis, CA (USA)**	
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AS05-77ER05399	**Brookhaven National Lab., Upton, NY**	
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AS05-78ET27161	**University of Southwestern Louisiana, Lafayette (USA). Dept. of Geology**	
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	University of Southwestern Louisiana, Lafayette (USA)	
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AS05-78EV05854	**Florida State Univ., Tallahassee**	
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AS05-83ER60159	**Georgia State Univ., Atlanta (USA)**	
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AS07-76ID01523	**Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering**	
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AS07-79ID12057	**Texas Univ., Austin (USA). Bureau of Economic Geology**	
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AS07-80ID12082	**Idaho National Engineering Lab., Idaho Falls (USA)**	
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AS08-76DP00563	**Hawaii Univ., Honolulu (USA). Dept. of Mechanical Engineering**	
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AS08-81DP40137	**Washington Univ., Seattle (USA). Dept. of Nuclear Engineering**	
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AS20-81LC10652	**Colorado State Univ., Fort Collins**	
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AT01-79ER10025	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	9:25935	DOE/ER/10025—T2
AT03-76CS51101	**Aerospace Corp., El Segundo, CA (USA)**	
	9:25709	ATR—77(7523-22)-3
	9:25710	ATR—78(7695-05)-1
AT03-76ET21060	**Aerospace Corp., El Segundo, CA (USA). Energy Projects Directorate**	
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AT03-76ET51011	**GA Technologies, Inc., San Diego, CA (USA)**	
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AT03-80ER10708	**California Univ., Davis (USA). Dept. of Mechanical Engineering**	
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AT03-80SF11458	**Institute of Geophysics and Planetary Physics University of California, Riverside, CA**	
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AT03-81ER10865	**Stanford Univ., CA (USA). Edward L. Ginzton Lab.**	
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AT03-81ER10870	**California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials**	
	9:26277	CALT—822-138
AT03-81SF11528	**GA Technologies, Inc., San Diego, CA (USA)**	
	9:25477	GA-A—17292
	9:25504	GA-A—17322
	9:25505	GA-A—17391
AT03-81SF11561	**Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group**	
	9:25936	ESG-DOE—13425
AT03-84ER51044	**GA Technologies, Inc., San Diego, CA (USA)**	
	9:27531	GA-A—17471
AT03-84ER53158	**GA Technologies, Inc., San Diego, CA (USA)**	
	9:27465	GA-A—17386
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AT03-84SF11962	**GA Technologies, Inc., San Diego, CA (USA)**	
	9:25921	GA-A—17351
	9:25923	GA-A—17526
AT03-84SF11963	**GA Technologies, Inc., San Diego, CA (USA)**	
	9:25922	GA-A—17460
	9:25958	GA-A—17549
	9:25983	GA-A—17509
AT04-81AL16228	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	9:25713	DOE/JPL—1060-62
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AT06-76EV71005	**Purdue Univ., West Lafayette, IN**	
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AT06-76EV75026	**Univ. of Washington, Seattle**	
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FC01-80RG10511	**Oklahoma Corp. Commission, Oklahoma City (USA)**	
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FC03-77SF10501	**Southern California Edison Co., Rosemead (USA)**	
	9:25716	DOE/SF/10501—009
	9:25717	DOE/SF/10501—013
	Solar One Visitor Center, Daggett, CA (USA)	
	9:25718	DOE/SF/10501—T13
	Sandia National Labs., Livermore, CA (USA)	
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	San Bernardino County Museum Association, Redlands, CA (USA)	
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FC03-78CS32137	**California, State of, Sacramento (USA)**	
	9:25762	DOE/CS/32137—T1
FC03-78CS35195	**Beck (Mark) Associates, Inc., Columbia, MD (USA)**	
	9:25767	DOE/CS/35195—T1
FC07-81ID12227	**National Food Processors Association, Berkeley, CA (USA)**	
	9:26231	DOE/ID/12227—T1
FC07-83ID12243	**Coury and Associates, Lakewood, CO (USA)**	
	9:26248	DOE/ID/12243—T1
FC20-78LC10787	**Geokinetics, Inc., Salt Lake City, UT (USA)**	
	9:25354	DOE/LC/10787—126
FC21-80MC14400	**TRW Energy Systems Group, Redondo Beach, CA (USA)**	
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	TRW Energy Development Group, Redondo Beach, CA (USA)	
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FC21-83FE60181	**Southern Research Inst., Birmingham, AL (USA)**	
	9:25251	DOE/FE/60181—47
FG01-78CS84006	**North Carolina State Univ., Raleigh (USA). School of Forest Resources**	
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FG01-78ET12240	**Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering**	
	9:25283	DOE/ET/12240—T1
FG01-78ET21040	**American Association for the Advancement of Science, Washington, DC. Office of Public Sector Programs**	
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FG01-78RG06566	**New Mexico State Government, Santa Fe (USA)**	
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FG01-79CS20233	**Bi-State Development Agency, St. Louis, MO (USA)**	
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FG01-80CS23977	**Rhode Island Governor's Energy Office, Providence (USA)**	
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FG01-80EI10667	**Stanford Univ., CA (USA). Energy Modeling Forum**	
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FG01-80EI11702	**Massachusetts Office of Energy Resources, Boston (USA)**	
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FG01-80MI02503	**Prairie View A and M Univ., TX (USA). Center for Energy Affairs**	
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FG01-80RG10407	**Wyoming Public Service Commission, Cheyenne (USA)**	
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FG01-81CS15074	**Pugh (Paul F.) and Associated Professional Engineers, Oakland, CA (USA). Energy Conservative Cable Dept.**	
	9:25879	DOE/CS/15074—T4
FG01-81FE30081	**Alaska Univ., Fairbanks (USA). Geophysical Inst.**	
	9:26151	DOE/FE/30081—T1
FG01-83PE70502	**American Enterprise Inst. for Public Policy Research, Washington, DC**	
	9:25317	DOE/PE/70502—T1
FG02-79ET00078	**Southern Illinois Univ., Edwardsville (USA). Dept. of Physics**	
	9:25791	DOE/ET/00078—T1
FG02-79ET00085	**Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics**	
	9:25589	DOE/ET/00085—T1

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FG02-79R510161	**Strand Associates, Inc., Madison, WI (USA)**	
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FG02-80CS84055	**Southern Illinois Univ., Carbondale (USA). Dept. of Thermal and Environmental Engineering**	
	9:25769	DOE/CS/84055—T1
FG02-80CS89501	**California Univ., Los Angeles (USA). School of Engineering and Applied Science**	
	9:25737	DOE/CS/89501—T1
FG02-80ER10726	**State Univ. of New York, Buffalo (USA). Nuclear Science and Technology Facility**	
	9:27054	DOE/ER/10726—1
FG02-81AF92002	**Department of Mechanical and Industrial Engineering, University of Ilinois at Urbana-Champaign, Urban**	
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FG02-81R510330	**Solar Energy Engineering, Poland, OH (USA)**	
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FG03-76ER10058	**California Inst. of Tech., Pasadena**	
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FG03-83ER40082	**California Univ., Irvine (USA)**	
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FG05-80ET53088	**Texas Univ., Austin (USA). Inst. for Fusion Studies**	
	9:27528	DOE/ET/53088—135
FG06-79R000003	**Washington State Energy Office, Olympia (USA)**	
	9:26264	WAOENG—83-24
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FG22-80PC30216	**Washington State Univ., Pullman (USA). Dept. of Mechanical Engineering**	
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FG22-80PC30234	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mining and Minerals Engineering**	
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FG22-81PC40771	**USDOE Pittsburgh Energy Technology Center, PA**	
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FG22-81PC40793	**Western Kentucky Univ., Bowling Green (USA). Ogden Coll. of Science, Technology and Health**	
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FG22-81PC40797	**Rhode Island Univ., Kingston (USA). Dept. of Chemical Engineering**	
	9:25201	DOE/PC/40797—T3
FG22-81PC40799	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
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FG22-81PC40810	**North Dakota Univ., Grand Forks (USA)**	
	9:25203	DOE/PC/40810—9
FG22-82PC50786	**Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.**	
	9:25204	DOE/PC/50786—8
FG22-82PC50790	**Utah Univ., Salt Lake City (USA). Biomaterials Profiling Center**	
	9:25239	DOE/PC/50790—T5
	9:25240	DOE/PC/50790—T6
FG22-82PC50796	**California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering**	
	9:26515	DOE/PC/50796—T5
FG22-82PC50797	**California Univ., Riverside (USA)**	
	9:25276	DOE/PC/50797—T5
FG22-82PC50798	**Colorado Univ., Boulder (USA)**	
	9:25205	DOE/PC/50798—7
FG22-82PC50800	**Illinois Univ., Urbana (USA)**	
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FG22-82PC50813	**West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography**	
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FG22-82PC50816	**Brigham Young Univ., Provo, UT (USA)**	
	9:25620	DOE/PC/50816—6
FG22-82PC51260	**Univ. of Rhode Island, Narragansett**	
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FG22-83PC60054	**Pittsburgh Univ., PA (USA)**	
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FG22-83PC60798	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering**	
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FG22-83PC60799	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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FG22-83PC60802	**Arizona Univ., Tucson (USA). Dept. of Chemical Engineering**	
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FG22-83PC60811	**Pennsylvania State Univ., University Park (USA)**	
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FG22-83PC60813	**Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering**	
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FG45-80CS69104	**Michigan Energy Administration, Lansing (USA)**	
	9:25768	DOE/CS/69104—1
	Michigan Dept. of Commerce, Lansing (USA)	
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FG47-80R701102	**Central States Energy Research Corp., Iowa City, IA (USA)**	
	9:25808	DOE/R7/01102—T1
FG47-80R701134	**KXL, Inc., St. Louis, MO (USA)**	
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FG47-80R701154	**Smith (John W.), Overland Park, KS (USA)**	
	9:25772	DOE/R7/01154—T1
FG47-80R701162	**Finney (Oliver), Lawrence, KS (USA)**	
	9:25773	DOE/R7/01162—T1
FG47-81R701201	**Clarinda, City of, IA (USA)**	
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FG47-81R701227	**Nebraska Univ., Lincoln (USA). Solar Resource Development Office**	
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FG47-81R701242	**Missouri Univ., Maysville (USA). Extension Center**	
	9:26203	DOE/R7/01242—T1
FG47-81R701249	**Engineering Applications, Inc., Rolla, MO (USA)**	
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NAS-7-100-955902	**Solarex Corp., Rockville, MD (USA)**	
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NAS-7-100-956254	**General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.**	
	9:25675	DOE/JPL/956254—2
NAS-7-100-956616	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.**	
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W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
	9:25181	ANL/FE—83-28
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	9:27513	CONF-840614—34
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W-7405-ENG-26	**Dept. of Energy**	
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83-274	NTIS (US Sales Only), PC A09 MF/A01; 1	DE84750943	MN -95	9:26242
83-311	NTIS (US Sales Only), PC A07/MF A01	DE84751260	MN -12	9:25895
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83-008	*See* N-8411349			9:26651
83-030	NTIS (US Sales Only), PC A08 MF/A01; 1	DE84750929	MN -94c	9:26077
BMI-				
1983-002	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, (Germany, F.R.)			9:26001
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9(83-3)	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010584	STD -70	9:25484
492	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011620	STD -70	9:25485
502	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010927	STD -70	9:25486
525	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012023	STD -70	9:25487
527	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010625	STD -70	9:25488
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33860	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84002688	MN -34D	9:26814
34185	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010513	MN -28	9:26770
34342	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007695	MN -4	9:26274
34477	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010789	MN -34A	9:27253
34479	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010287	MN -94ca	9:26078
34518	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010788	MN -28	9:26798
34523	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010224	MN -4	9:27128
34525	NTIS, PC A02; 3 (GPO Dep.)	DE84010291	MN -34D	9:26799
34530	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010292	MN -11	9:27045
34548	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010288	MN -21	9:27506
34580	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010798	MN -34	9:26432
34582	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010282	MN -34D	9:27274
34592	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010896	MN -34D	9:27275
34595	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010890	MN -25	9:26275
34597	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010791	MN -41	9:27226
34603	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010792	MN -32	9:27630
34604	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010797	MN -34	9:27437
34614	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010799	MN -34D	9:26771
34625	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010895	MN -28	9:26780
34630	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010893	MN -34D	9:27276
51755	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011529	STD -11	9:27069
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34141	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007379	MN -79	9:26002
34212	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006751	MN -78	9:26003
34213	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010883	MN -79e	9:25929
34243	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007374	MN -80	9:25968
34244	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007375	MN -78	9:25896
34245	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006759	MN -79	9:26004
34267	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84006756	MN -80	9:26005
34270	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010514	MN -25	9:26276
34425	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010515	MN -70	9:26425
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34546	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010281	MN -80	9:25969
34563	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010466	MN -77	9:26009
34596	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010800	MN -70	9:25489
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81-9E	Canada Centre for Mineral and Energy Technology, Ottawa, Ontario			9:25250
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412	*See* DOE/ET/34013-8	DE84010495	STD -78	9:25898
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83-09	NTIS (US Sales Only), PC A03/MF A01	DE84701394	MN -34D	9:27446
CONF-7609221-	(International conference on photochemical oxidant pollution and its control, Raleigh, NC, USA, 12-17 Sep 1976)			
1	*See* PB-264232	DE84900921	MN -11	9:26993
CONF-780133-	(Direct use of geothermal energy, San Diego, CA, USA, 31 Jan-2 Feb 1978)			
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CONF-7803144-	(Joint meeting of Society of Plastics Engineers and the Fire Retardant Chemicals Association, Houston, TX, USA, 12-15 Mar 1978)			
1	NTIS, PC A03/MF A01	DE84900943	MN -41	9:27197
CONF-790444-	(Offshore technology conference, Houston, TX, USA, 30 Apr-4 May 1979)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009331	MN -64	9:25734
CONF-790634-	(72. annual Air Pollution Control Association meeting, Cincinnati, OH, USA, 24-28 Jun 1979)			
7	NTIS, PC A02/MF A01; 1	DE84900897	MN -11	9:26931
CONF-790803-	(14. intersociety energy conversion conference, Boston, MA, USA, 5-10 Aug 1979)			
67	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009396	MN -64	9:25735
CONF-8006191-	(3. international carbon conference, Baden-Baden, F.R. Germany, 30 Jun-4 Jul 1980)			
	See Juel-Conf-36			9:26444
CONF-801210-	(3. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 15-17 Dec 1980)			
	Alternative Energy Sources, 1: 3-25(Dec 1980)			9:25662
	Alternative Energy Sources, 8: 3-42(Dec 1980)			9:25786
	Alternative Energy Sources, 8: 43-50(Dec 1980)			9:25787
	Alternative Energy Sources, 2: 397-413(Dec 1980)			9:25788
	Alternative Energy Sources, 1: 249-263(Dec 1980)			9:25807
CONF-8105249-	(AAAS regional energy seminar - energy independence: consequences for human health, Berkeley, CA, USA, 28-29 May 1981)			
Summ.	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009741	MN -41	9:26119
CONF-811048-	(International symposium on indoor air pollution, health and energy conservation, Amherst, MA, USA, 13-16 Oct 1981)			
Summs.	NTIS, PC A23/MF A01; 1 (GPO Dep.)	DE84004447	MN -41	9:27186
CONF-811113-	(American Vacuum Society national symposium, Anaheim, CA, USA, 3-6 Nov 1981)			
59-Draft	NTIS, PC A02; 3 (GPO Dep.)	DE84004584	MN -20a	9:27507
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	Proc. Jpn. Conf. Radioisot., No. 15, 272-281(1982)			9:27153
CONF-8205234-	(9. cellulose conference, Syracuse, NY, USA, 24-27 May 1982)			
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CONF-820718-	(21. international conference on high energy physics, Paris, France, 26-31 Jul 1982)			
51	*See* JINR-E-1-82-759	DE84701443	MN -34D	9:27292
CONF-820762-	(5. meeting of the Pacific Northwest working Group on nuclear track registration, Richland, WA, USA, 28 Jul 1982)			
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2	NTIS, PC A02; 1 (GPO Dep.)	DE84009330	MN -64	9:25736
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	J. Phys. (Paris), Colloq., 977-982(Jun 1983)			9:26457
CONF-830141-	(Workshop on media with microstructure and wave propagation, Houghton, MI, USA, 24-25 Jan 1983)			
5	*See* UCRL-90234	DE84011066	MN -25	9:27238
CONF-830340-	(International conference on heavy-ion physics and nuclear physics, Catania, Italy, 21-26 Mar 1983)			
	Nucl. Phys. A, 409: 109-112(14 Nov 1983)			9:27393
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	Helv. Phys. Acta, 56: No. 4, 978(3 Oct 1983)			9:27304
CONF-8304105-	(6. international tandem conference, Chester, UK, 16-23 Apr 1983)			
6	*See* RL-83-049	DE84700947	MN -28	9:26776
CONF-830573-	(2. international conference on radiation effects in insulators, Albuquerque, NM, USA, 30 May-3 Jun 1983)			
10	*See* PNL-SA-11394	DE84010951	MN -25	9:26450
CONF-8305173-	(23. conference on physics of interaction of charged particles with crystals, Moscow, USSR, 1 May-1 Jun 1983)			
1	*See* JINR-R-17-83-291	DE84701401	MN -34A	9:27431
CONF-830665-	(Health Physics Society summmer school on internal radiation dosimetry, Catonsville, MD, USA, 12-17 Jun 1983)			
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010523	MN -41	9:27164
CONF-830692-	(6. North American forest soils conference, Knoxville, TN, USA, 19-23 Jun 1983)			
2	*See* DOE/OR/21363-1	DE84011139	MN -11	9:27055
CONF-8306126-	(American Society of Agricultural Engineers summer meeting, Bozeman, MT, USA, 26-29 Jun 1983)			
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CONF-8306131-	(Asia Pacific Physics conference, Singapore, Singapore, 12-18 Jun 1983)			
3	*See* FIAS-R-116	DE84700882	MN -34A	9:27256
CONF-8306174-	(14. international symposium on multiparticle dynamics, Granlibakken, CA, USA, 22-27 Jun 1983)			
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CONF-8306179-	(Working meeting on problems of radiation and detection of gravitational waves, Dubna, USSR, 7-9 Jun 1983)			
1	*See* JINR-R-2-83-340	DE84701387	MN -34D	9:27451
CONF-830718-	(International Europhysics conference on high energy physics, Brighton, UK, 20-27 Jul 1983)			
23	*See* DESY-83-104	DE84751269	MN -34D	9:27307
24	*See* DESY-83-108	DE84751271	MN -34D	9:27281
25	*See* DESY-83-103	DE84751275	MN -34D	9:27280
CONF-830759-	(16. annual technical meeting of the International Metallographic Society, Calgary, Canada, 25-28 Jul 1983)			
4	*See* Y/DV-304	DE84008513	MN -25	9:26351
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3-Rev.1	*See* UCRL-88420-Rev.1	DE84011056	MN -92a	9:25337
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31	*See* LBL-16528	DE84008242	MN -20c	9:27547
CONF-830862-	(10. international conference on few-body problems in physics, Karlsruhe, F.R. Germany, 21-27 Aug 1983)			
16	*See* TRI-PP-83-129	DE84900955	MN -34D	9:27348
CONF-8308101-	(International symposium on lepton and photon interactions at high energies, Ithaca, NY, USA, 4-9 Sep 1983)			
11	*See* DESY-83-111	DE84751272	MN -34D	9:27282
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5	*See* BONN-HE-83-21	DE84751267	MN -34D	9:27277
CONF-8308157-	(18. assembly of the International Union of Geodesy and Geophysics, Hamburg, F.R. Germany, 15 Aug-27 Sep 1983)			
7	*See* UCRL-88882	DE84009871	MN -66	9:25830
CONF-8308166-	(21. meeting of the International School of Subnuclear Physics, Erice, Italy, 3-14 Aug 1983)			
1	*See* BNL-34592	DE84010896	MN -34D	9:27275
CONF-8308167-	(11. international time series meeting, Toronto, Canada, 18-21 Aug 1983)			
1	*See* BNL-34603	DE84010792	MN -32	9:27630
CONF-830911-	(5. international conference on high power particle beams, San Francisco, CA, USA, 12-14 Sep 1983)			
39	*See* UCRL-88924	DE84010558	MN -28	9:26793
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85	*See* UCRL-89002	DE84010993	MN -20c	9:26350

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3	*See* PNL-SA-11751	DE84011169	MN -46	9:25986
CONF-8309118-	(Topical meeting on free electron generation of extreme ultraviolet coherent radiation, Upton, NY, USA, 19-22 Sep 1983)			
9	*See* BNL-34625	DE84010895	MN -28	9:26780
CONF-8309223-	(1. international workshop on carcinogenic and/or mutagenic metals, Geneva, Switzerland, 11-14 Sep 1983)			
	See SVC-83-38			9:25292
CONF-8309229-	(Acta/Scripta conference, Sonnenberg, F.R. Germany, 19-23 Sep 1983)			
1	*See* LBL-17369	DE84010802	MN -25	9:26407
CONF-831011-	(American Vacuum Society symposium, Boston, MA, USA, 31 Oct-4 Nov 1983)			
6	*See* PPPL-2048	DE84006281	STD -20	9:27553
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43	*See* TRI-PP-83-106	DE84900956	MN -34C	9:26830
46	NTIS, PC A02/MF A01 (GPO Dep.)	DE84002055	MN -80	9:25982
47	*See* BNL-33860	DE84002688	MN -34D	9:26814
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32	*See* Y/DK-354	DE84010725	MN -4	9:25399
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	Trans. Am. Nucl. Soc., 45: 226(Oct 1983)			9:27180
CONF-831069-	(5. conference on atmospheric radiation, Baltimore, MD, USA, 31 Oct-3 Nov 1983)			
5	*See* LBL-16425	DE84007973	MN -59c	9:25657
CONF-831086-	(Electrochemical Society fall meeting, Washington, DC, USA, 9-14 Oct 1983)			
13	*See* BNL-34479	DE84010287	MN -94ca	9:26078
CONF-8310157-	(29. annual conference on bioassay, analytical and environmental chemistry, Seattle, WA, USA, 12-13 Oct 1983)			
4	*See* PNL-SA-11388	DE84010627	MN -70B	9:25532
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8	*See* PNL-SA-11331	DE84010702	MN -90a	9:25245
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2	*See* LA-UR-84-866	DE84010056	MN -34C	9:26805
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CONF-8310268-	(International symposium on concepts of fatigue crack growth threshold, Philadelphia, PA, USA, 2-6 Oct 1983)			
1	*See* LBL-16263	DE84009669	MN -25	9:26329
CONF-831106-	(Topical meeting on safeguards technology - the process safeguards interface, Hilton Head Island, SC, USA, 28 Nov-1 Dec 1983)			
25	*See* PNL-SA-11842	DE84011269	MN -16	9:25580
CONF-831174-	(Materials Research Society annual meeting, Boston, MA, USA, 14-17 Nov 1983)			
85	*See* PNL-SA-11573	DE84010776	MN -70	9:25517
CONF-831180-	(3. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 14-18 Nov 1983)			
	American Institute of Physics, 355 East 45th St., New York, NY 10017		ND -34A	9:26800
CONF-8311110-	(6. workshop on environmental research for actinide elements, Hilton Head Island, SC, USA, 7-11 Nov 1983)			
2	*See* PNL-SA-11777	DE84011360	MN -11	9:27169
3	*See* PNL-SA-11778	DE84010877	MN -11	9:27170
CONF-8311122-	(20. annual meeting of PNWIS-APCA, Seattle, WA, USA, 16-18 Nov 1983)			
2	*See* PNL-SA-11531	DE84010900	MN -11	9:26994
CONF-8311134-	(EPRI workshop on the electrochemistry of zinc/halogen batteries, Palo Alto, CA, USA, 30 Nov-1 Dec 1983)			
5	*See* SAND-84-0685C	DE84008973	MN -94c	9:26083
CONF-8311151-	(Royal Society of Chemistry international congress on catalysis, London, UK, 7 Nov 1983)			
1	*See* LBL-16983	DE84010707	MN -4	9:26268
CONF-831203-	(10. symposium on fusion engineering, Philadelphia, PA, USA, 5-9 Dec 1983)			
117	*See* UCRL-89292	DE84008347	MN -21	9:27563
137	*See* SAND-83-1248C	DE84003763	MN -21	9:27559
138-Rev.1	*See* UCRL-89966-Rev.1	DE84011053	MN -20	9:27564
CONF-831264-	(Workshop on accelerator physics issues for a superconducting super collider, Ann Arbor, MI, USA, 12-17 Dec 1983)			
14	*See* LBL-17283	DE84010719	MN -28	9:26789
15	*See* BNL-34185	DE84010513	MN -28	9:26770
CONF-831265-	(6. international conference on lasers and applications, San Francisco, CA, USA, 12-16 Dec 1983)			
4	*See* LA-UR-84-1190	DE84011371	MN -34	9:26668
CONF-831274-	(5. parabolic dish solar thermal power program annual review meeting, Indian Wells, CA, USA, 6-8 Dec 1983)			
	See DOE/JPL-1060-69	DE84008503	STD -62	9:25715
CONF-831276-	(Computer networks symposium, Silver Spring, MD, USA, 13 Dec 1983)			
1	*See* LBL-16254	DE84010706	MN -32	9:27632
CONF-840113-	(Symposium on space nuclear power systems, Albuquerque, NM, USA, 10-13 Jan 1984)			
8	*See* LA-UR-84-1238	DE84011384	MN -33	9:25947
CONF-840140-	(International symposium on solid state physics under pressure, Izu-Nagaoka, Japan, 18-21 Jan 1984)			
3	*See* BNL-34580	DE84010798	MN -34	9:26432
CONF-840142-	(International symposium on heavy ion accelerators and their applications to inertial fusion, Tokyo, Japan, 23-27 Jan 1984)			
5	*See* LBL-17256	DE84009225	MN -21	9:27548

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6	*See* LBL-17255	DE84008497	MN -21	9:26774
7	*See* BNL-34548	DE84010288	MN -21	9:27506
8	*See* LBL-17561	DE84010804	MN -28	9:26790
9	*See* UCRL-90240	DE84011054	MN -21	9:27566
9-Rev.1	*See* UCRL-90240-Rev.1	DE84011057	MN -20	9:27567
10	*See* UCRL-90241	DE84011052	MN -21	9:27568
CONF-840150-	(4. Moriond workshop on massive neutrinos in particle and astro-physics, La Plagne, France, 15-21 Jan 1984)			
4	*See* UCRL-90687	DE84011071	MN -34D	9:27302
CONF-840152-	(International workshop on hyperfine interactions, Kanpur, India, 16-25 Jan 1984)			
1	*See* MLM-3139(OP)	DE84009863	MN -34C	9:27441
CONF-840153-	(NATO workshop on ices in the solar system, Nice, France, 16-19 Jan 1984)			
1	*See* LA-UR-84-919	DE84010069	MN -34B	9:27245
CONF-840154-	(PSSC fixed target workshop, Woodland, TX, USA, 27-29 Jan 1984)			
1	*See* BNL-34614	DE84010799	MN -34D	9:26771
CONF-840202-	(17. midyear topical meeting of the Health Physics Society, Pasco, WA, USA, 5-9 Feb 1984)			
23	*See* PNL-SA-11889	DE84008299	MN -11	9:27063
CONF-840218-	(113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Los Angeles, CA, USA, 26 Feb-2 Mar 1984)			
7	*See* SAND-83-1690C	DE84010131	MN -25	9:26344
CONF-840245-	(6. symposium on management of uranium mill tailings, low-level waste, and hazardous waste, Fort Collins, CO, USA, 1-3 Feb 1984)			
12	*See* PNL-SA-11684	DE84010699	MN -70A	9:2[illegible]18
13	*See* PNL-SA-11821	DE84010844	MN -11	9:[illegible]3519
14	*See* PNL-SA-11643	DE84011270	MN -70B	9:25533
CONF-840255-	(6. US-Japan symposium on compact toroid research, Princeton, NJ, USA, 20-23 Feb 1984)			
4	*See* LA-UR-84-622	DE84007490	MN -20d	9:27472
5	*See* LA-UR-84-621	DE84007494	MN -20d	9:27471
8	*See* LA-UR-84-620	DE84007492	MN -20d	9:27470
12	*See* LA-UR-84-626	DE84007493	MN -20d	9:27473
13	*See* LA-UR-84-624	DE84007497	MN -20d	9:27544
14	*See* LA-UR-84-623	DE84007491	MN -20d	9:27543
18	*See* LA-UR-84-748	DE84010064	MN -20d	9:27474
19	*See* LA-UR-84-870	DE84010054	MN -20f	9:27545
CONF-840258-	(Materials Research Society spring meeting, Albuquerque, NM, USA, 27-29 Feb 1984)			
5	*See* SAND-83-2173C	DE84009929	MN -25	9:26452
6	*See* SAND-83-2012C	DE84010976	MN -25	9:26451
7	*See* SAND-84-0454C	DE84008987	MN -25	9:26409
CONF-840264-	(Workshop on high energy excitations in condensed matter, Los Alamos, NM, USA, 13-15 Feb 1984)			
5	*See* BNL-34604	DE84010797	MN -34	9:27437
CONF-840269-	(NAPAP Task Group G peer review meeting, Burlington, VT, USA, 14-17 Feb 1984)			
6	*See* PNL-SA-11978	DE84010697	MN -11	9:26125
7	*See* PNL-SA-11979	DE84010701	MN -11	9:26117
CONF-840275-	(Workshop on anti pp options for the SSC, Chicago, IL, USA, 13-17 Feb 1984)			
3	*See* SLAC-PUB-3300	DE84010575	MN -34D	9:27347
4	*See* ANL-HEP-CP-84-09	DE84010729	MN -28	9:26769
5	*See* LA-UR-84-1009	DE84009981	MN -34D	9:27345
CONF-840276-	(3. annual Office Systems Research conference, Los Angeles, CA, USA, 18-19 Feb 1984)			
1	*See* PNL-SA-12058	DE84008649	MN -13	9:27629
CONF-840280-	(Recontre de Moriond meeting on electro weal interactions and unified theories, La Plaque, France, 26 Feb-4 Mar 1984)			
1	*See* SLAC-PUB-3320	DE84010677	MN -34D	9:27384
2	*See* BNL-34630	DE84010893	MN -34D	9:27276
CONF-840282-	(15. southeastern conference on combinatorics, graph theory and computing, Baton Rouge, LA, USA, 5-8 Feb 1984)			
1	*See* SAND-84-0183C	DE84010975	MN -13	9:27707
CONF-840283-	(Workshop on energy from municipal waste research, Argonne, IL, USA, 22-24 Feb 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010520	MN -95e	9:26243
CONF-840307-	(Waste management '84, Tucson, AZ, USA, 11-15 Mar 1984)			
26	*See* PNL-SA-11685	DE84008678	MN -70	9:25478
27	*See* PNL-SA-12022	DE84008662	MN -85	9:25479
29	*See* BNL-NUREG-34430	DE84010516	MN -78	9:26006
30	*See* BNL-NUREG-34425	DE84010515	MN -70	9:26425
32	*See* DP-MS-83-94	DE84011135	MN -70	9:25498
CONF-840311-	(4. international symposium on heating in toroidal plasmas, Rome, Italy, 21-28 Mar 1984)			
9	*See* GA-A-17471	DE84011314	MN -20a	9:27531
CONF-840387-	(2. topical meeting on laser techniques in the extreme ultraviolet, Boulder, CO, USA, 5-7 Mar 1984)			
2	*See* UCRL-90089	DE84008348	MN -21	9:27565
6	*See* LBL-17686	DE84010715	MN -28	9:26812
7	*See* LA-UR-84-1384	DE84011347	MN -34	9:26669

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CONF-840389-	(US-Japan information exchange seminar on photochemical energy solar conversion, Okazaki, Japan, 12-15 Mar 1984)			
4	*See* LA-UR-84-788	DE84010060	MN -34C	9:27382
CONF-840396-	(International conference on instrumentation for colliding beam physics, Novosibirsk, USSR, 15-21 Mar 1984)			
2	*See* BNL-34525	DE84010291	MN -34D	9:26799
CONF-8403100-	(Conference of Z-pinches for fusion, Alexandria, VA, USA, 29-30 Mar 1984)			
4	*See* UCRL-90330	DE84011317	MN -20	9:27569
CONF-8403101-	(3. winter workshop on nuclear dynamics, Copper Mountain, CO, USA, 5-9 Mar 1984)			
4	NTIS, PC A02; 3 (GPO Dep.)	DE84008580	MN -20g	9:27390
5	*See* LA-UR-84-761	DE84010063	MN -34C	9:27410
6	*See* LA-UR-84-823	DE84010062	MN -34C	9:27411
CONF-8403108-	(SUGI conference, Hollywood, FL, USA, 18-21 Mar 1984)			
1	NTIS, PC A02; 3 (GPO Dep.)	DE84008521	MN -70	9:25495
CONF-8403112-	(International symposium on nuclear spectroscopy and nuclear interactions, Osaka, Japan, 21-24 Mar 1984)			
2	*See* BNL-34582	DE84010282	MN -34D	9:27274
3	*See* LBL-17575	DE84010716	MN -34C	9:27399
4	*See* LA-UR-84-1293	DE84011383	MN -34D	9:27398
CONF-8403113-	(Europhysics conference, Erice, Italy, 4-11 Mar 1984)			
1	*See* LBL-17673	DE84010720	MN -34D	9:27298
CONF-8403114-	(International conference on ground water quality, Tulsa, OK, USA, 26 Mar 1984)			
1	*See* PNL-SA-11728	DE84010773	MN -11	9:27060
CONF-8403115-	(Workshop on lung modeling for inhalation of radioactive materials, Oxford, UK, 26-28 Mar 1984)			
1	*See* PNL-SA-12130	DE84010845	MN -48	9:27172
2	*See* PNL-SA-12101	DE84010703	MN -41	9:27171
CONF-8403116-	(Government Industrial Research Institute seminar, Osaka, Japan, 23 Mar-9 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010505	MN -94cb	9:26079
CONF-8403118-	(International symposium on the Qinghai-Xizang Plateau and mountain meterorology, Beijing, China, 20-24 Mar 1984)			
1	*See* LA-UR-84-808	DE84010059	MN -11	9:26927
CONF-8403119-	(OHOLO conference on boundary layer structure, Zichron Ya'acov, Israel, 25-28 Mar 1984)			
1	*See* PNL-SA-12119	DE84010778	MN -11	9:26929
CONF-8403120-	(American Association for the Advancement of Science conference, Lubbock, TX, USA, 27-28 Mar 1984)			
1	*See* LA-UR-84-1139	DE84011335	MN -94b	9:26069
CONF-840402-	(6. annual ASME Solar Energy Division technical conference, Las Vegas, NV, USA, 10-12 Apr 1984)			
3	*See* SERI/TP-253-2157	DE84000096	STD -59c	9:25809
6	*See* SERI/TP-252-2170	DE84004436	STD -62e	9:25783
CONF-840405-	(NACE corrosion '84 international forum and exhibition, New Orleans, LA, USA, 1-6 Apr 1984)			
12	*See* BNL-34595	DE84010890	MN -25	9:26275
CONF-840408-	(5. international conference on nuclear methods in environmental and energy research, Mayaguez, Puerto Rico, 2-6 Apr 1984)			
7	*See* UCRL-89876	DE84009609	MN -4	9:26475
10	*See* PNL-SA-11740	DE84010647	MN -4	9:25236
CONF-840411-	(3. meeting on liquid metal in energy applications, Oxford, UK, 9-13 Apr 1984)			
19	*See* HEDL-SA-2957-FP	DE84011117	MN -79	9:25993
CONF-840412-	(American power conference, Chicago, IL, USA, 24-26 Apr 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010653	MN -79i	9:25930
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010529	MN -79	9:26012
4	*See* GA-A-17509	DE84011156	MN -77	9:25983
5	*See* GA-A-17549	DE84011155	MN -77	9:25958
CONF-840415-	(187. national meeting of the American Chemical Society, St. Louis, MO, USA, 8-13 Apr 1984)			
20	*See* LA-UR-84-1235	DE84011354	MN -4	9:27260
CONF-840417-	(High-temperature alloys - theory and design conference, Bethesda, MD, USA, 8-12 Apr 1984)			
1	*See* K/PS-5017	DE84010901	MN -4	9:26469
Absts.	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010428	MN -25	9:26278
CONF-840449-	(2. symposium on resonance ionization spectroscopy and its applications, Knoxville, TN, USA, 16-20 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010656	MN -34A	9:27254
2	*See* LA-UR-84-1325	DE84011334	MN -4	9:26470
CONF-840481-	(Atomic physics program contractors workshop, Gaithersburg, MD, USA, 26-27 Apr 1984)			
5	*See* BNL-34477	DE84010789	MN -34A	9:27253
CONF-840488-	(Low level nuclear waste cleanup conference, Arlington, VA, USA, 16-17 Apr 1984)			
1	*See* PNL-SA-12198	DE84010705	MN -41	9:25571
CONF-840496-	(8. AIAA aerodynamic decelerator and balloon technology conference, Hyannis, MA, USA, 2-4 Apr 1984)			
11	*See* SAND-84-0188C	DE84008849	MN -35	9:26905

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CONF-8404103-	(2. international conference on creep and fracture of engineering materials and structures, Swansea, UK, 1-6 Apr 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011458	MN -25	9:26280
CONF-8404120-	(Association of system 2000 users for technical exchange conference, Austin, TX, USA, 30 Apr-4 May 1984)			
3	*See* BNL-34597	DE84010791	MN -41	9:27226
CONF-8404121-	(17. oil shale symposium, Golden, CO, USA, 16-18 Apr 1984)			
3	*See* SAND-83-2678C	DE84010304	MN -91	9:25352
4	*See* SAND-83-2603C	DE84010303	MN -91	9:25373
CONF-8404125-	(IAEA specialists' meeting on heat exchanger components for gas cooled reactors, Dusseldorf, F.R. Germany, 16-19 Apr 1984)			
1	*See* GA-A-17460	DE84008856	MN -77	9:25922
2	*See* GA-A-17351	DE84009865	MN -77	9:25921
CONF-8404126-	(86. annual general meeting of Canadian Institute of Mining, Ottawa, Canada, 15-18 Apr 1984)			
1	*See* LA-UR-84-868	DE84010055	MN -38	9:26648
CONF-8404129-	(DNA direct course symposium, Adelphi, MD, USA, 9-13 Apr 1984)			
1	*See* SAND-84-0297C	DE84009932	MN -35	9:26906
CONF-8404131-	(Scanning electron microscopy conference, Philadelphia, PA, USA, 15-20 Apr 1984)			
1	*See* UCRL-90257	DE84008801	MN -11	9:27239
CONF-8404133-	(3. international RETRAN meeting, Las Vegas, NV, USA, 9-11 Apr 1984)			
1	*See* UNI-SA-120	DE84009869	MN -80	9:25995
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010518	MN -78	9:26018
CONF-8404134-	(Veterinary Post-Graduate Institute seminar, Santa Cruz, CA, USA, 27-29 Apr 1984)			
1	*See* PNL-SA-12069	DE84010700	MN -48	9:27120
CONF-8404135-	(International conference on metallurgical coatings, San Diego, CA, USA, 9 Apr 1908)			
1	*See* PNL-SA-12159	DE84010780	MN -25	9:26335
CONF-8404136-	(USE conference, Dallas, TX, USA, 2 Apr 1984)			
1	*See* SAND-84-0919C	DE84010972	MN -32	9:27641
CONF-8404138-	(8. national engineering symposium of the Mexican American Engineering Society, Albuquerque, NM, USA, 11-13 Apr 1984)			
2	*See* LA-UR-84-1231	DE84011331	MN -13	9:27088
3	*See* LA-UR-84-1395	DE84011364	MN -37	9:26911
CONF-8404139-	(Solar central receiver annual meeting, San Diego, CA, USA, 24-26 Apr 1984)			
2	*See* LA-UR-84-1284	DE84011339	MN -48	9:27198
CONF-840504-	(Southeastern conference on theoretical and applied mechanics, Pine Mountain, GA, USA, 10-11 May 1984)			
2	*See* SAND-83-1522C	DE84010536	MN -34	9:27456
CONF-840529-	(Linear accelerator conference, Darmstadt-Seeheim, F.R. Germany, 7-11 May 1984)			
4	*See* UCRL-90243	DE84010553	MN -28	9:26794
5	*See* SLAC-PUB-3328	DE84011197	MN -28	9:26809
6	*See* SLAC-PUB-3329	DE84010966	MN -28	9:26810
7	*See* LA-UR-84-1191	DE84011348	MN -28	9:26782
8	*See* LA-UR-84-1349	DE84011416	MN -28	9:26788
9	*See* LA-UR-84-1217	DE84011332	MN -28	9:26783
10	*See* LA-UR-84-1280	DE84011326	MN -28	9:26785
11	*See* LA-UR-84-1279	DE84011327	MN -28	9:26784
12	*See* LA-UR-84-1348	DE84011417	MN -28	9:26807
13	*See* LA-UR-84-1232	DE84011330	MN -28	9:26806
14	*See* LA-UR-84-1308	DE84011366	MN -28	9:26773
21	*See* LA-UR-84-1282	DE84011407	MN -28	9:26786
24	*See* LA-UR-84-1342	DE84011343	MN -28	9:26787
CONF-840531-	(6. annual symposium on safeguards and nuclear material management, Venice, Italy, 14-18 May 1984)			
1	*See* SAND-84-0964C	DE84010601	MN -15	9:25581
CONF-840543-	(International symposium on alcohol fuels technology, Ottawa, Ontario, Canada, 21-25 May 1984)			
1	*See* SERI/TP-232-2240	DE84000100	STD -61A	9:26263
CONF-840561-	(17. IEEE photovoltaic specialists conference, Kissimmee, FL, USA, 1-4 May 1984)			
2	*See* SAND-83-2033C	DE84010932	MN -63	9:25685
3	*See* SAND-83-2015C	DE84010979	MN -63	9:25705
5	*See* SAND-83-2014C	DE84011194	MN -63b	9:25684
6	*See* SAND-84-0963C	DE84011192	MN -63b	9:25687
7	*See* SAND-84-0243C	DE84011190	MN -63c	9:25686
8	*See* SAND-83-2117C	DE84011188	MN -63	9:25706
9	*See* SAND-84-0993C	DE84011187	MN -63	9:25707
CONF-840577-	(30. international instrumentation symposium, Denver, CO, USA, 7-10 May 1984)			
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006449	MN -90h	9:25273
CONF-8405111-	(American Gas Association natural gas distribution and transmission conference, San Francisco, CA, USA, 7-9 May 1984)			
1	*See* SAND-84-0727C	DE84008946	MN -92a	9:25340

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CONF-8405120-	(SPE/DOE/GRI gas recovery symposium, Pittsburgh, PA, USA, 13-15 May 1984)			
7	*See* SAND-84-7129C	DE84011189	MN -92a	9:25334
CONF-8405144-	(International groundwater symposium, Montreal, Quebec, Canada, 21-23 May 1984)			
1	*See* BNL-NUREG-34596	DE84010800	MN -70	9:25489
CONF-8405145-	(IMOG/NSG meeting, Tampa, FL, USA, 15-16 May 1984)			
1	*See* SAND-84-0856C	DE84010602	MN -32	9:27640
CONF-8405147-	(4. Jerusalem conference on information technology, Jersualem, Israel, 26 May 1984)			
1	*See* UCRL-90351	DE84011072	MN -32	9:27645
CONF-8405148-	(2. annual DPMA software maintenance symposium, Washington, DC, USA, 7-9 May 1984)			
1	*See* SAND-84-0581C	DE84011205	MN -32	9:27639
CONF-840604-	(12. international symposium on effects of radiation on materials, Williamsburg, VA, USA, 18-20 Jun 1984)			
3	*See* DOE/ER/52089-3	DE84010784	MN -20c	9:26311
5	*See* HEDL-SA-3005-FP	DE84010397	MN -25	9:26317
CONF-840611-	(International gas turbine conference and exhibit, Amsterdam, Netherlands, 4-7 Jun 1984)			
1	NTIS, PC A03/MF A01	DE84003641	MN -90f	9:26756
CONF-840612-	(Air Pollution Control Association annual meeting, San Francisco, CA, USA, 25-28 Jun 1984)			
4	*See* DOE/FE/60181-47	DE84010472	MN -90i	9:25251
5	NTIS, PC A02; 3 (GPO Dep.)	DE84010728	MN -11	9:26973
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010527	MN -90i	9:25274
CONF-840614-	(Annual meeting of the American Nuclear Society, New Orleans, LA, USA, 3-8 Jun 1984)			
1	NTIS, PC A02/MF A01	DE84004017	MN -79	9:26013
3	*See* UCRL-90116	DE84004815	MN -78	9:26061
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84005265	MN -80	9:25970
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84005427	MN -79k	9:26014
13	*See* UCRL-90166	DE84005893	MN -46	9:26062
14	*See* LA-UR-84-169	DE84006018	MN -21	9:27541
15	*See* LA-UR-84-168	DE84006017	MN -21	9:27540
16	*See* LA-UR-84-64	DE84006008	MN -80	9:25956
18	*See* LA-UR-84-170	DE84006019	MN -20d	9:27542
19	*See* SAND-84-0130C	DE84006289	MN -79g	9:26057
20	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006404	MN -20d	9:27508
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006407	MN -79k	9:25931
23	NTIS, PC A03/MF A01 (GPO Dep.)	DE84006408	MN -20d	9:27509
24	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006443	MN -20d	9:27510
26	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006441	MN -20d	9:27511
28	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006413	MN -79p	9:25959
30	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006598	MN -78	9:25883
31	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006553	MN -80	9:25960
32	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006742	MN -20d	9:27512
33	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006716	MN -80	9:25932
34	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006743	MN -20c	9:27513
35	*See* BNL-NUREG-34212	DE84006751	MN -78	9:26003
36	*See* BNL-NUREG-34245	DE84006759	MN -79	9:26004
37	*See* BNL-NUREG-34267	DE84006756	MN -80	9:26005
38	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006744	MN -79c	9:26015
39	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006554	MN -20d	9:27514
41	*See* BNL-NUREG-34243	DE84007374	MN -80	9:25968
42	*See* BNL-NUREG-34244	DE84007375	MN -78	9:25896
43	*See* BNL-NUREG-34141	DE84007379	MN -79	9:26002
47	*See* BNL-NUREG-34213	DE84010883	MN -79e	9:25929
48	*See* BNL-NUREG-34563	DE84010466	MN -77	9:26009
49	*See* BNL-NUREG-34544	DE84010894	MN -41	9:26008
CONF-840616-	(International conference on plasma physics, Lausanne, Switzerland, 27 Jun-3 Jul 1984)			
1	*See* GA-A-17483	DE84009188	MN -20a	9:27466
2	*See* GA-A-17386	DE84009402	MN -20a	9:27465
3	*See* LA-UR-84-1062	DE84009989	MN -21	9:27546
4	*See* LA-UR-84-1063	DE84009988	MN -21	9:27477
6	*See* LA-UR-84-1127	DE84010004	MN -34	9:27478
7	*See* SAND-84-0406C	DE84010145	MN -20	9:26752
8	*See* LA-UR-84-923	DE84009970	MN -20f	9:27475
9	*See* UCRL-90425	DE84009683	MN -20g	9:27487
10	*See* UCRL-90451	DE84008944	MN -20a	9:27488
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008945	MN -21	9:27515
12	*See* LA-UR-84-942	DE84009973	MN -34	9:27476
CONF-840629-	(13. international quantum electronics conference, Anaheim, CA, USA, 18-21 Jun 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006663	MN -34A	9:27255
CONF-840632-	(Advances in probabilistic structural mechanics symposium, San Antonio, TX, USA, 17-21 Jun 1984)			
1	*See* UCRL-90509	DE84008325	MN -38	9:26657
CONF-840633-	(25. US symposium on rock mechanics, Evanston, IL, USA, 25-27 Jun 1984)			
3	*See* SAND-83-2342C	DE84008025	MN -70	9:25521
4	*See* SAND-84-0135C	DE84008026	MN -35	9:26904
5	*See* SAND-83-2563C	DE84009066	MN -92a	9:25338
6	*See* SAND-83-2345C	DE84009457	MN -92	9:25331

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7	*See* SAND-84-0512C	DE84009523	MN -92a	9:25339
12	*See* LBL-17521	DE84010781	MN -11	9:27237
CONF-840636-	(ACM SIGCOMM '84 symposium on communications architectures and protocols, Montreal, Canada, 6-8 Jun 1984)			
Rev.1	*See* UCRL-83604-Rev.1	DE84002724	MN -32	9:27644
CONF-840647-	(ASME pressure vessel and piping conference, San Antonio, TX, USA, 17-21 Jun 1984)			
1	NTIS, PC A03/MF A01 (GPO Dep.)	DE84004031	MN -38	9:26682
3	*See* UCRL-90049	DE84003897	MN -38	9:26655
6	NTIS, PC A3/MF A01; 1 (GPO Dep.)	DE84007277	MN -80	9:26016
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84007272	MN -79e	9:26017
8	*See* DOE/ET/34019-4	DE84008013	MN -80	9:25900
11	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84009155	MN -79a	9:25933
12	*See* HEDL-SA-3050	DE84008498	MN -79	9:26022
13	*See* BNL-NUREG-34546	DE84010281	MN -80	9:25969
15	*See* BNL-NUREG-34502	DE84010891	MN -80	9:26007
17	*See* UCRL-90514	DE84011051	MN -80	9:26063
CONF-840651-	(ASHRAE semi-annual conference, Kansas City, MO, USA, 24-28 Jun 1984)			
1	*See* LBL-16645	DE84004239	MN -95d	9:26210
CONF-840652-	(American Control conference, San Diego, CA, USA, 6-8 Jun 1984)			
1	*See* HEDL-SA-3020-FP	DE84004828	MN -79m	9:25984
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84005705	MN -90c	9:25183
CONF-840653-	(8. international conference on high energy rate fabrication, San Antonio, TX, USA, 17-21 Jun 1984)			
1	*See* LA-UR-83-3422	DE84003818	MN -38	9:26703
3	*See* UCRL-90142	DE84006133	MN -38	9:26908
CONF-840664-	(9. international congress on metallic corrosion, Toronto, Canada, 3-7 Jun 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84005411	MN -25	9:26279
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009152	MN -4	9:26404
6	*See* BNL-NUREG-34270	DE84010514	MN -25	9:26276
CONF-840666-	(American Society for Testing of Materials meeting on rocks and soils, Philadelphia, PA, USA, 1 Jun 1984)			
1	*See* UCRL-90281	DE84006135	MN -38	9:26656
CONF-8406100-	(International conference on lightning and static electricity, Orlando, FL, USA, 22-28 Jun 1984)			
1	*See* SAND-83-2306C	DE84009064	MN -38	9:26671
2	*See* SAND-83-2254C	DE84009065	MN -38	9:26751
CONF-8406101-	(5. international congress on experimental mechanics, Montreal, Quebec, Canada, 10-14 Jun 1984)			
1	*See* SAND-83-1766C	DE84009067	MN -38	9:26887
2	*See* DP-MS-84-13	DE84010152	MN -25	9:26313
3	*See* UCRL-88933	DE84010688	MN -11	9:25522
CONF-8406103-	(Technology of propellants and high explosives annual conference, Fraunhofer, F.R. Germany, 27-29 Jun 1984)			
1	*See* UCRL-90376	DE84008244	MN -45	9:26909
CONF-8406104-	(Topical meeting on ultrafast phenomena, Monterey, CA, USA, 12-15 Jun 1984)			
1	NTIS, PC A02; 3 (GPO Dep.)	DE84008258	MN -4	9:26666
2	*See* KMSF-U-1445	DE84009485	MN -21	9:2753
CONF-8406107-	(14. collegium internationale neuro-psychopharmacologicum, Florence, Italy, 19-23 Jun 1984)			
1	*See* BNL-34523	DE84010224	MN -4	9:27128
CONF-8406112-	(International symposium on characterization of heavy crude oils and petroleum residues, Lyon, France, 25-27 Jun 1984)			
1	*See* LBL-17477	DE84009245	MN -92b	9:25327
CONF-8406114-	(Optical Society of America conference on lasers and electro-optics, Anaheim, CA, USA, 19-22 Jun 1984)			
1	*See* LBL-17386	DE84010718	MN -4	9:26471
CONF-840702-	(5. world hydrogen energy conference, Toronto, Canada, 15-19 Jul 1984)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008986	MN -21	9:25600
CONF-840804-	(Intersociety energy conversion engineering conference, San Francisco, CA, USA, 19-24 Aug 1984)			
7	*See* LA-UR-84-1381	DE84011414	MN -33	9:25948
CONF-840813-	(Design, construction and operation of nuclear power plants conference, Portland, OR, USA, 5-8 Aug 1984)			
9	*See* LA-UR-84-1319	DE84011411	MN -78	9:26031
10	*See* SAND-83-2653C	DE84008998	MN -80	9:26056
CONF-840901-	(ANS topical meeting on physics and shielding, Chicago, IL, USA, 17-19 Sep 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009202	MN -79d	9:25961
COO-				
2456/ 84	*See* DOE/ET/53016-94	DE84010389	STD -20g	9:27464
DESY-				
83-088	NTIS (US Sales Only), PC A04 MF/A01	DE84750941	MN -34D	9:27278
83-102	NTIS (US Sales Only), PC A04/MF A01	DE84751274	MN -34D	9:27279
83-103	NTIS (US Sales Only), PC A03/MF A01	DE84751275	MN -34D	9:27280
83-104	NTIS (US Sales Only), PC A03/MF A01	DE84751269	MN -34D	9:27307
83-105	NTIS (US Sales Only), PC A07/MF A01	DE84751273	MN -34D	9:27308
83-108	NTIS (US Sales Only), PC A02/MF A01	DE84751271	MN -34D	9:27281
83-111	NTIS (US Sales Only), PC A03/MF A01	DE84751272	MN -34D	9:27282

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DL/NUC/TM-62A	NTIS (US Sales Only), PC A02/MF A01	DE84700943	MN -28	9:26772
DOE/BP-190	NTIS, PC A09; 3 (GPO Dep.)	DE84010328	MN -58	9:25654
207	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009720	MN -59	9:25757
DOE/CE-0062	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010938	MN -60	9:25857
0072	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010679	STD -63	9:25672
DOE/CE/15095-10	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007530	STD -59	9:26163
11	NTIS, PC A04/MF A01 (GPO Dep.)	DE84010632	STD -95d	9:26195
DOE/CH/10122-11	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84009180	MN -59	9:25758
20	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009899	MN -59	9:26164
24	NTIS, PC A06; 3 (GPO Dep.)	DE84010658	MN -59a	9:25759
25	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84009474	MN -59c	9:25760
DOE/CL/11200-T6	NTIS, PC A06/MF A01 (GPO Dep.)	DE84006607	STD -79p	9:25934
DOE/CS/15074-T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008982	MN -97a	9:25879
DOE/CS/20074-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010367	MN -95d	9:26244
T3	NTIS, PC A06; 3 (GPO Dep.)	DE84010371	MN -95d	9:26245
DOE/CS/20233-T1	NTIS, PC A08; 3 (GPO Dep.)	DE84010865	MN -95e	9:26246
DOE/CS/20286-1	NTIS, PC A12; 3 (GPO Dep.)	DE84010671	MN -95	9:26196
DOE/CS/20411-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84008917	MN -95d	9:26197
DOE/CS/20448-T4	NTIS, PC A04; 1 (GPO Dep.)	DE84010740	MN -95d	9:26103
T5	NTIS, PC A03; 3 (GPO Dep.)	DE84010738	MN -95d	9:26104
T6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010732	MN -95d	9:26105
T7	NTIS, PC A04; 3 (GPO Dep.)	DE84010733	MN -95d	9:26106
T8	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010743	MN -95d	9:26198
DOE/CS/23977-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008824	MN -95a	9:26199
DOE/CS/30003-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010372	MN -95d	9:26200
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010375	MN -95d	9:26201
DOE/CS/30396-T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84009622	MN -58e	9:25652
DOE/CS/30569-33	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010824	STD -59a	9:25761
DOE/CS/32137-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009418	MN -59a	9:25762
DOE/CS/32378-T2-Vol.1	NTIS MF A01; 2	DE84001026	MN -59a	9:25763
T2-Vol.2	NTIS MF A01; 2	DE84001604	MN -59a	9:25764
DOE/CS/32382-T3	NTIS, PC A03; 3 (GPO Dep.)	DE84009200	MN -59a	9:25765
T4	NTIS, PC A12; 3 (GPO Dep.)	DE84009163	MN -59a	9:25766
DOE/CS/35195-T1	Mark Beck Associates, Inc., Three Lakefront North, 5570 Sterrett Place, Columbia, MD 21044; 3 (GPO Dep.)		ND -59a	9:25767
DOE/CS/69104-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010430	MN -58a	9:25768
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008913	MN -95d	9:26202
DOE/CS/84006-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011596	MN -61A	9:25673
DOE/CS/84055-T1	NTIS, PC A04; 3 (GPO Dep.)	DE84008221	MN -59b	9:25769
DOE/CS/89501-T1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84011174	MN -64	9:25737
DOE/DP/00563-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010524	MN -25	9:26285
DOE/DP/40124-14	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010415	MN -21	9:27516
16	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84010417	MN -21	9:27517
40	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011150	MN -21	9:27518
DOE/DP/40137-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011260	MN -21	9:27519
DOE/EI/10667-T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010590	MN -98B	9:25313
T2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010296	MN -98B	9:26107
DOE/EI/11702-T1	NTIS, PC A03; 3 (GPO Dep.)	DE84010866	MN -98D	9:26090
DOE/EIA-0035(84/ 01)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84010884	MN -98	9:26147
0109(84/ 02)	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84010543	MN -98B	9:25314
0121(83/ 4Q)	NTIS, PC A05/MF A01; - GPO (GPO Dep.)	DE84010351	MN -98A	9:25289
0130(84/ 02)	NTIS, PC A06/MF A01; - GPO (GPO Dep.)	DE84010427	MN -98	9:26148
0149(83)	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	DE84010157	MN -98	9:26088
0226(84/ 01)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84008556	MN -98E	9:26152
0292(83)	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84010533	MN -98	9:25290

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0380(84/ 01)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84008514	MN -98B	9:25315
0380(84/ 02)	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011713	MN -98B	9:25316
0384(83)	NTIS, PC A12/MF A01; 1 - GPO (GPO Dep.)	DE84010482	MN -98	9:26159
0391(84)	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011315	MN -98	9:26149
0420/ 1	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	DE84010851	MN -98	9:26138
DOE/EIS-				
0005-FS	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010949	MN -11	9:27091
0005-FS-2	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84011249	MN -11	9:27092
0030	NTIS, PC A24/MF A01; 1 (GPO Dep.)	DE84011234	MN -11	9:27093
0030-FS-1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84011248	MN -11	9:27094
0077-FS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010950	MN -11	9:27095
DOE/ER-				
0045/ 11	NTIS, PC A11/MF A01 (GPO Dep.)	DE84007335	STD -20c	9:27520
0191	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011362	MN -2	9:27625
0193	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010980	MN -13	9:27626
0194	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010764	STD -11	9:27227
DOE/ER/01198-				
1407	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84008664	MN -25	9:26310
DOE/ER/03409-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011509	MN -80	9:25992
DOE/ER/10025-				
T2	NTIS, PC A05; 3 (GPO Dep.)	DE84008633	MN -79	9:25935
DOE/ER/10434-				
5	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007402	MN -34C	9:27397
DOE/ER/10624-				
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011254	MN -4	9:26466
DOE/ER/10660-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010424	MN -4	9:26549
DOE/ER/10691-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011387	MN -11	9:26247
DOE/ER/10708-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010862	MN -25	9:26405
DOE/ER/10726-				
1	NTIS, PC A02; 3 (GPO Dep.)	DE84003023	MN -4	9:27054
DOE/ER/10865-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010327	MN -34	9:26748
DOE/ER/10957-				
3	NTIS, PC A02; 3 (GPO Dep.)	DE84010546	MN -34D	9:27309
DOE/ER/10980-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011593	MN -4	9:26513
DOE/ER/10982-				
3	NTIS, PC A07/MF A01 (GPO Dep.)	DE84011245	MN -90a	9:25237
DOE/ER/13067-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011390	MN -38	9:26571
DOE/ER/40082-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010346	MN -34D	9:27273
DOE/ER/52089-				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010784	MN -20c	9:26311
DOE/ER/53126-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84010814	MN -20	9:27462
DOE/ER/60159-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010803	MN -4	9:26558
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009339	MN -62	9:25791
DOE/ET/00085-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008312	MN -61E	9:25589
DOE/ET/10815-				
89	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84005855	STD -90g	9:26168
DOE/ET/12240-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011397	MN -90e	9:25283
DOE/ET/13397-				
18	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84008202	STD -90d	9:25184
19	NTIS, PC A07/MF A01 (GPO Dep.)	DE84008010	STD -90d	9:25185
DOE/ET/14371-				
T1	NTIS, PC A07/MF A01 (GPO Dep.)	DE84010471	STD -91	9:25353
DOE/ET/14928-				
1540	NTIS, PC A04/MF A01 (GPO Dep.)	DE84005447	STD -90c	9:25186
DOE/ET/17094-				
1503	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009274	STD -90f	9:26638
DOE/ET/20265-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007817	MN -59c	9:25792
DOE/ET/20342-				
T4	NTIS, PC A02; 3 (GPO Dep.)	DE84009335	MN -64	9:25738
T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009327	MN -64	9:25739
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009325	MN -64	9:25740
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009390	MN -64	9:25741
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009393	MN -64	9:25742
T10	NTIS, PC A02; 3 (GPO Dep.)	DE84009333	MN -64	9:25743
DOE/ET/21060-				
3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84008925	MN -62	9:25712
DOE/ET/23198-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84009463	MN -58	9:25663
DOE/ET/27161-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011273	MN -66	9:25812
T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011471	MN -66a	9:25820

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T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011469	MN -66	9:25821
T3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011467	MN -66	9:25822
T4	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011468	MN -66	9:25823
DOE/ET/29108-				
T1-Pt.1	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84010348	MN -97c	9:25867
T1-Pt.2	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84010347	MN -97c	9:25868
DOE/ET/29123-				
T1	NTIS, PC A04; 3 (GPO Dep.)	DE84011277	MN -97c	9:26080
DOE/ET/29212-				
T1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84001244	MN -97	9:26120
DOE/ET/29365-				
6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010589	MN -97b	9:26091
7	NTIS, PC A05; 3 (GPO Dep.)	DE84010588	MN -97	9:26749
8	NTIS, PC A11; 3 (GPO Dep.)	DE84010330	MN -97	9:25869
9	NTIS, PC A05; 3 (GPO Dep.)	DE84010339	MN -97	9:25870
10	NTIS, PC A07; 3 (GPO Dep.)	DE84010329	MN -97	9:25871
DOE/ET/34006-				
13	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	DE84010631	STD -78	9:25884
DOE/ET/34013-				
8	NTIS (US Sales Only), PC A11/MF A01; 1 (GPO Dep.)	DE84010495	STD -78	9:25898
DOE/ET/34015-				
7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84008859	STD -78	9:25899
DOE/ET/34019-				
4	NTIS, PC A02; 3 (GPO Dep.)	DE84008013	MN -80	9:25900
DOE/ET/34212-				
42	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	DE84011607	STD -78	9:25901
DOE/ET/34213-				
11	NTIS (US Sales Only), PC A04/MF A01; 1 (GPO Dep.)	DE84011605	STD -78	9:25902
DOE/ET/51013-				
120	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010577	STD -20g	9:27463
DOE/ET/52021-				
T1	NTIS MF A01; 2 (GPO Dep.)	DE84008865	MN -20	9:27526
DOE/ET/52028-				
1	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011389	MN -20	9:27527
DOE/ET/53016-				
94	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84010389	STD -20g	9:27464
DOE/ET/53088-				
135	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010968	MN -20g	9:27528
DOE/ET/60004-				
T3	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011237	MN -98E	9:26108
T4	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84011238	MN -98	9:26150
T5	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84011236	MN -98B	9:25298
DOE/EV/01300-				
48	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010929	MN -48	9:27117
DOE/EV/03382-				
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010503	MN -48	9:27165
DOE/EV/10081-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010867	MN -11	9:26925
DOE/FE-				
0038	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009879	STD -90	9:25872
DOE/FE/30081-				
T1	NTIS MF A01; 2 (GPO Dep.)	DE84008916	MN -92a	9:26151
DOE/FE/60181-				
47	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010472	MN -90i	9:25251
DOE/GJ/01660-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010477	MN -51	9:25388
DOE/ID-				
10113	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011885	STD -61F	9:25619
DOE/ID/01523-				
4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010394	MN -66d	9:25849
DOE/ID/12057-				
T6	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010826	MN -66a	9:25829
DOE/ID/12079-				
89	NTIS, PC A06/MF A01 (GPO Dep.)	DE84012193	MN -66a	9:25835
103	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012187	MN -66a	9:25850
106	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012189	MN -66a	9:25836
109	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012188	MN -66a	9:25837
DOE/ID/12082-				
83	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84009634	MN -11	9:27028
DOE/ID/12227-				
T1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84010956	MN -95f	9:26231
DOE/ID/12243-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011028	STD -95f	9:26248
DOE/ID/12293-				
T1	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011172	STD -95f	9:26232
DOE/JPL-				
1060-62	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84009157	STD -62b	9:25713
1060-64	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008507	STD -62	9:25793
1060-67	NTIS, PC A04/MF A01 (GPO Dep.)	DE84008501	STD -62	9:25714
1060-69	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84008503	STD -62	9:25715
DOE/JPL/955902-				
83/ 11	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84011716	STD -63b	9:25674
DOE/JPL/956254-				
2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010981	STD -63b	9:25675

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DOE/JPL/956616-				
83/ 2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011548	STD -63b	9:25676
DOE/LC/10787-				
126	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011125	STD -91	9:25354
DOE/MA-				
0064/ 2-Vol.3	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84009778	MN -13	9:26132
0064/ 2-Vol.4	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84009779	MN -13	9:26133
0064/ 2-Vol.5	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84009782	MN -13	9:26153
0148	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010528	MN -13	9:27627
DOE/MC/14400-				
1603	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011419	STD -90c	9:25187
1604	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011421	STD -90c	9:25188
1605	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011420	STD -90c	9:25189
1606	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011422	STD -90c	9:25190
1607	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011423	STD -90c	9:25191
DOE/MC/19404-				
T16	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009300	MN -92a	9:25265
DOE/METC/SP-				
201	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84003048	STD -90c	9:25192
DOE/MI/02503-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011129	MN -98	9:27087
DOE/NASA-				
0007-1	*See* N-8410661			9:25864
0168-5	*See* N-8410581			9:26253
0189-83/ 2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84011322	STD -96	9:26256
0241-7	*See* N-8411581			9:26172
DOE/NASA/0249-				
83/ 1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010642	STD -96	9:26257
DOE/NBM-				
1073-Vol.2	NTIS, PC A11; 3 (GPO Dep.)	DE84008599	STD -15	9:25578
4005845	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84005845	MN -97e	9:25649
DOE/NOAA/OTEC-				
40	*See* PB-83-221374		MN -64	9:25751
44	*See* PB-83-222059		MN -64	9:25754
49	*See* PB-83-221093		MN -64	9:25746
52	*See* PB-83-221309		MN -64	9:25750
53	*See* PB-83-221945		MN -64	9:25753
64	*See* PB-83-221184		MN -64	9:25749
65	*See* PB-83-221853		MN -64	9:25752
66	*See* PB-83-221143		MN -64	9:25747
70	*See* PB-83-222109		MN -64	9:25755
76	*See* PB-83-221176		MN -64	9:25748
DOE/NV/10150-				
4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011831	STD -66a	9:25851
DOE/NV/10327-				
4	NTIS, PC A10/MF A01; 1	DE84011606	STD -11	9:27029
DOE/OR/03054-				
13	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011319	STD -89	9:25193
56	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011553	STD -89	9:25194
70	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010983	STD -89	9:25195
88	NTIS, PC A05/MF A01 (GPO Dep.)	DE84011851	STD -89	9:25196
90	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010809	STD -89	9:26312
98	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011883	STD -89	9:25197
DOE/OR/21363-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011139	MN -11	9:27055
DOE/PC/30187-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84003147	STD -90a	9:26514
DOE/PC/30216-				
T10	NTIS, PC A08/MF A01 (GPO Dep.)	DE84006830	STD -90b	9:25284
DOE/PC/30234-				
T3	NTIS, PC A09/MF A01 (GPO Dep.)	DE84009555	STD -90b	9:25275
DOE/PC/40091-				
T8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010742	STD -90d	9:25198
DOE/PC/40784-				
T3	NTIS, PC A07/MF A01 (GPO Dep.)	DE84008012	STD -90d	9:25199
DOE/PC/40785-				
11	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011843	STD -90d	9:25200
DOE/PC/40793-				
T9	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84006651	STD -90a	9:25238
DOE/PC/40797-				
T3	NTIS, PC A03; 3 (GPO Dep.)	DE84010039	MN -90d	9:25201
DOE/PC/40799-				
T9	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011131	STD -90d	9:25202
DOE/PC/40810-				
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011520	STD -90d	9:25203
DOE/PC/50786-				
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010560	STD -90d	9:25204
DOE/PC/50790-				
T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011432	STD -90a	9:25239
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011441	STD -90a	9:25240
DOE/PC/50796-				
T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010822	MN -90c	9:26515
DOE/PC/50797-				
T5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010469	MN -90	9:25276

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DOE/PC/50798-7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011884	MN -90c	9:25205
DOE/PC/50800-T6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010468	MN -90a	9:25206
DOE/PC/50813-4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010876	MN -90a	9:25241
DOE/PC/50816-6	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010727	STD -90d	9:25620
DOE/PC/60015-12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010414	STD -90d	9:25207
DOE/PC/60045-T2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010476	STD -90d	9:25208
DOE/PC/60048-2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011720	STD -90d	9:25209
DOE/PC/60053-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010318	MN -90d	9:25210
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010467	MN -88	9:25266
DOE/PC/60054-T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010885	MN -90d	9:25211
DOE/PC/60798-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010552	MN -90a	9:25212
DOE/PC/60799-1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010863	STD -90a	9:25213
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011138	STD -90a	9:25242
DOE/PC/60802-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010723	MN -90i	9:25285
DOE/PC/60811-1-2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010500	STD -90d	9:25214
DOE/PC/60813-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011558	MN -90a	9:25215
DOE/PC/63032-T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010293	MN -90a	9:25216
DOE/PE/06419-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84006091	MN -95	9:26109
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006092	MN -95	9:26110
T3	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84006087	MN -95	9:26111
T5	NTIS, PC A08/MF A01 (GPO Dep.)	DE84006086	MN -95	9:26112
DOE/PE/70502-T1	American Enterprise Inst. for Public Policy Research, 1150 17th Street, N.W., Washington, DC 20036; 3		ND -98B	9:25317
DOE/PO/10850-2-Vol.3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010695	STD -92	9:25324
DOE/PR/06010-T33	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84008548	STD -95f	9:26233
DOE/R5/10161-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011209	MN -95	9:26249
DOE/R5/10330-2	NTIS, PC A04; 3 (GPO Dep.)	DE84008632	MN -59c	9:25770
T1	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830		ND -59c	9:25771
DOE/R7/01102-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84007732	MN -59c	9:25808
DOE/R7/01134-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84007860	MN -61D	9:25632
DOE/R7/01154-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84007850	MN -59c	9:25772
DOE/R7/01162-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010014	MN -59a	9:25773
DOE/R7/01201-T1	NTIS, PC A03; 3 (GPO Dep.)	DE84010102	MN -59a	9:25774
DOE/R7/01227-T1	NTIS, PC A09; 3 (GPO Dep.)	DE84009768	MN -59c	9:25655
DOE/R7/01242-T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010456	MN -95d	9:26203
DOE/R7/01249-T1	NTIS, PC A06; 3 (GPO Dep.)	DE84010434	MN -95e	9:26234
DOE/RA/50154-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84009738	MN -97	9:26092
DOE/RA/50164-T1	NTIS, PC A19; 3 (GPO Dep.)	DE84009845	MN -64	9:25744
DOE/RA/50278-1	NTIS, PC A17; 3 (GPO Dep.)	DE84008672	STD -95f	9:26235
DOE/RG/06405-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84009513	MN -58a	9:25664
T4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010374	MN -58a	9:25665
DOE/RG/06566-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84008891	MN -98E	9:26154
DOE/RG/10407-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008888	MN -98E	9:26093
DOE/RG/10511-T1	NTIS, PC A14; 3 (GPO Dep.)	DE84007325	MN -98E	9:26155
DOE/RL/10153-T1-Vol.1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010909	MN -78	9:25903
T1-Vol.2	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84010916	MN -78	9:25904
T1-Vol.3	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84010915	MN -78	9:25905
T1-Vol.4	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84010914	MN -78	9:25906

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T1-Vol.6-Pt.1	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84010910	MN -78	9:25919
T1-Vol.6-Pt.2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010904	MN -78	9:25916
T1-Vol.7	NTIS, PC A18/MF A01; 1 (GPO Dep.)	DE84010911	MN -78	9:25907
T1-Vol.8-Pt.1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84010912	MN -78	9:25955
T1-Vol.9-Pt.1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84010907	MN -78	9:25918
T1-Vol.9-Pt.2	NTIS, PC A19; 3 (GPO Dep.)	DE84010906	MN -78	9:25920
T1-Vol.10	NTIS, PC A22; 3 (GPO Dep.)	DE84010905	MN -78	9:25908
T1-Vol.11-Pt.1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010903	MN -78	9:25957
T1-Vol.12	NTIS, PC A17; 3 (GPO Dep.)	DE84010917	MN -78	9:25909
Vol.11-Pt.2	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84010659	MN -78	9:25910
DOE-RW-				
82.109	*See* ANS-325	DE84700978	MN -70	9:25483
83.022	*See* AERE-G-2665	DE84700975	MN -70	9:25480
83.084	NTIS (US Sales Only), PC A05/MF A01	DE84700979	MN -70	9:25496
DOE/SF/10501-				
005	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84009974	MN -62c	9:27051
009	NTIS, PC A10; 3 (GPO Dep.)	DE84008896	MN -62c	9:25716
013	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008955	MN -62	9:25717
T13	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84006353	MN -62	9:25718
DOE/SF/10539-				
12	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84011450	MN -62	9:25719
DOE/SF/11564-				
6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012410	STD -92a	9:25299
DOE/SF/11727-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010759	STD -66	9:25848
DOE/TIC-				
4585-R4	NTIS, PC A99/MF A01; 1	DE84003877	STD -2	9:27651
DOE/US/31018-				
T1	NTIS, PC A04; 3 (GPO Dep.)	DE84010734	MN -98B	9:25318
DP-				
1662	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010670	STD -70	9:25497
1671	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010928	STD -4	9:25395
DP-MS-				
83-94	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011135	MN -70	9:25498
84-13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010152	MN -25	9:26313
DP-tr-				
66	NTIS, PC A02; 3 (GPO Dep.)	DE84010373	MN -10	9:25402
DPST-				
82-617	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011516	MN -11	9:25989
E/ECE-				
1063	United Nations, New York, NY			9:26094
EFI-				
547(34) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701416	MN -34D	9:27310
550(37) -82	NTIS (US Sales Only), PC A03/MF A01	DE84701417	MN -34D	9:27311
579(66) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701359	MN -34D	9:27272
584(71) -82	NTIS (US Sales Only), PC A03/MF A01	DE84701360	MN -34D	9:27355
585(72) -82	NTIS (US Sales Only), PC A03/MF A01	DE84701361	MN -34D	9:27356
586(73) -82	NTIS (US Sales Only), PC A03/MF A01	DE84701362	MN -34D	9:27357
587(74) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701395	MN -34A	9:26438
588(75) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701396	MN -34A	9:27439
591(78) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701407	MN -34B	9:27243
592(79) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701418	MN -34D	9:27312
595(82) -82	NTIS (US Sales Only), PC A03/MF A01	DE84701397	MN -34A	9:27422
596(83) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701449	MN -34D	9:27283
602(89) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701439	MN -34D	9:27284
608(95) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701363	MN -34D	9:27352
610(97) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701398	MN -34A	9:27423
EGG-				
2288	*See* NUREG/CR-3596	DE84010548	MN -78	9:26047
2292	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010583	STD -70	9:25499
2294-Vol.1	*See* NUREG/CR-3633-Vol.1	DE84011148	MN -78	9:26048
2294-Vol.2	*See* NUREG/CR-3633-Vol.2	DE84010544	MN -78	9:26049
2295	*See* NUREG/CR-3637	DE84008979	MN -80	9:25881
10282-2032	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011622	MN -11	9:27070
EGG-MS-				
6522	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011363	MN -78	9:25911
EGG-PBS-				
6554	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011182	MN -80	9:25885
EGG-SCM-				
6572	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011356	MN -25	9:26406
EGG-TMI-				
6531-Rev.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011032	MN -78	9:26019
EIR-				
431	NTIS (US Sales Only), PC A08/MF A01	DE84700951	MN -80	9:25886
443	NTIS (US Sales Only), PC A03/MF A01	DE84700899	MN -46	9:27424
455	NTIS (US Sales Only), PC A05/MF A01	DE84700884	MN -20	9:27529
459	NTIS (US Sales Only), PC A03/MF A01	DE84700958	MN -80	9:27425
462	NTIS (US Sales Only), PC A02 MF/A01	DE84750946	MN -62	9:25794
466	NTIS (US Sales Only), PC A06/MF A01	DE84701453	MN -46	9:27426
EML-				
427	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010758	STD -11	9:27030
EPA-				
600/ 3-77-001a	*See* PB-264232	DE84900921	MN -11	9:26993
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511-83-10	*See* PB-84-148014			9:26262
511-83-11	*See* PB-84-143577			9:26260
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511-83-13	*See* PB-84-145937			9:26222
EPRI-EA-				
3078	Research Reports Center, Box 50490, Palo Alto, CA 94303		ND -11	9:26974
3387	EPRI, Research Reports Center, Box 50490, Palo Alto, CA 94303		ND -97b	9:26156
EPRI-NP-				
3494	*See* NUREG/CR-3661	DE84900679	MN -78	9:26053
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3-AP-82-6	Environment Canada, Environmental Protection Service, Ottawa, Ontario			9:25243
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13425	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010412	STD -79b	9:25936
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109	*See* DOE/ID/12079-89	DE84012193	MN -66a	9:25835
120	*See* DOE/ID/12079-103	DE84012187	MN -66a	9:25850
123	*See* DOE/ID/12079-106	DE84012189	MN -66a	9:25836
126	*See* DOE/ID/12079-109	DE84012188	MN -66a	9:25837
EUR-				
6975	NTIS (US Sales Only), PC A04/MF A01	DE84700967	MN -78	9:26020
7415	NTIS (US Sales Only), PC A03/MF A01	DE84700976	MN -70	9:25500
7671	NTIS (US Sales Only), PC A11/MF A01	DE84700964	MN -78	9:25396
7775-DE	Commission of the European Communities, Luxembourg			9:26767
7789	NTIS (US Sales Only), PC A02/MF A01	DE84700939	MN -23	9:26467
7822	NTIS (US Sales Only), PC A04/MF A01	DE84700910	MN -86	9:25501
7867-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25217
7879	NTIS (US Sales Only), PC A08/MF A01	DE84700965	MN -78	9:25887
7985	NTIS (US Sales Only), PC A04/MF A01	DE84700948	MN -25	9:26801
7998	NTIS (US Sales Only), PC A03/MF A01	DE84700920	MN -25	9:26314
8017	NTIS (US Sales Only), PC A06/MF A01	DE84700940	MN -71	9:26639
8020	NTIS (US Sales Only), PC A07/MF A01	DE84700973	MN -37	9:25937
8030	NTIS (US Sales Only), PC A07/MF A01	DE84700986	MN -2	9:26640
8065-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25218
8118	NTIS (US Sales Only), PC A16/MF A01	DE84700963	MN -80	9:26021
8125-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25219
8156-FR	Commission of the European Communities, Luxembourg			9:25677
8186	NTIS (US Sales Only), PC A09/MF A01	DE84700984	MN -70	9:25502
8221	NTIS (US Sales Only), PC A18/MF A01	DE84700932	MN -41	9:25888
8254	NTIS (US Sales Only), PC A06/MF A01	DE84700941	MN -71	9:25476
8275	NTIS (US Sales Only), PC A05/MF A01	DE84700908	MN -4	9:26516
8325	NTIS (US Sales Only), PC A04/MF A01	DE84700974	MN -37	9:26641
8327-FR	Commission of the European Communities, Luxembourg			9:25678
8344	NTIS (US Sales Only), PC A04/MF A01	DE84700966	MN -78	9:25889
8345	NTIS (US Sales Only), PC A05/MF A01	DE84700942	MN -71	9:26642
8357	NTIS (US Sales Only), PC A08/MF A01	DE84700988	MN -32	9:25938
8360-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25267
8381-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25244
8382-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25220
8383-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25221
8391	NTIS (US Sales Only), PC A03/MF A01	DE84700989	MN -32	9:26643
8420	NTIS (US Sales Only), PC A02/MF A01	DE84700959	MN -80	9:27427
8423	NTIS (US Sales Only), PC A04/MF A01	DE84700927	MN -34B	9:26926
8424	NTIS (US Sales Only), PC A07/MF A01	DE84700985	MN -70	9:25503
8431-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25268
8502	NTIS (US Sales Only), PC A03/MF A01	DE84700911	MN -25	9:26315
8529	NTIS (US Sales Only), PC A02/MF A01	DE84701452	MN -34C	9:27379
8544-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25286
8561-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25222
8764-EN	Commission of the European Communities, Luxembourg			9:25873
8800-EN	Commission of the European Communities, Luxembourg			9:26095
8809-EN	Commission of the European Communities, Luxembourg			9:26096
8827-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:25269
FE-				
2559-16	*See* MTR-7814	DE84011229	MN -89	9:25224
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60799-1	*See* DOE/PC/60799-1	DE84010863	STD -90a	9:25213
60799-2	*See* DOE/PC/60799-2	DE84011138	STD -90a	9:25242
FEI-				
1266	NTIS (US Sales Only), PC A03/MF A01	DE84701411	MN -93	9:26170

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FERC/EIS-				
0037-Final-Draft	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84009774	MN -11	9:27083
FERMILAB-				
84/ 34	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010925	MN -41	9:27062
FERMILAB/TM-				
1252	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010878	MN -38	9:25880
FIAS-R-				
116	NTIS (US Sales Only), PC A02/MF A01	DE84700882	MN -34A	9:27256
FOA-C-				
30328-E1	*See* N-8411496			9:26670
FRA/ORD-				
81/ 73	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011134	MN -96	9:26220
FRNC-TH-				
1265	NTIS (US Sales Only), PC A09; 03	DE84751357	MN -59	9:25666
1397	NTIS (US Sales Only), PC A05; 03	DE84751352	MN -63	9:25679
1399	NTIS (US Sales Only), PC A07; 03	DE84751353	MN -63	9:25680
1400	NTIS (US Sales Only), PC A09; 03	DE84751354	MN -63	9:25681
1402	NTIS (US Sales Only), PC A07; 3	DE84751351	MN -59c	9:25795
1403	NTIS (US Sales Only), PC A09; 03	DE84751355	MN -62	9:25720
1422	NTIS (US Sales Only), PC A14; 03	DE84751356	MN -59	9:25796
FWC/FWDC/TR-				
84/ 12	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010794	STD -90b	9:25287
FWS/OBS-				
83/ 04	National Coastal Ecosystems Team, US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458		MN -11	9:27084
GA-A-				
17106	*See* UCRL-15593	DE84011058	MN -20c	9:27562
17275	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008592	MN -20a	9:27530
17292	NTIS, PC A04; 3 (GPO Dep.)	DE84010942	MN -83	9:25477
17322	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011023	STD -85	9:25504
17351	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009865	MN -77	9:25921
17386	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009402	MN -20a	9:27465
17391	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011026	STD -85	9:25505
17460	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008856	MN -77	9:25922
17471	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011314	MN -20a	9:27531
17483	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009188	MN -20a	9:27466
17509	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011156	MN -77	9:25983
17526	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011324	STD -77	9:25923
17549	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011155	MN -77	9:25958
GAT-				
4012	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010939	MN -11	9:27031
GEND-				
039	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010392	STD -78	9:25912
GEPP-EM-				
806	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011161	MN -11	9:27032
GEPP-TIS-				
785	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010765	MN -13	9:26427
GJBX-				
32(83)	*See* LA-9897-MS	DE84011004	STD -51	9:25389
GPO-				
22-828	*See* N-8411204			9:25949
GSI-				
83-12	NTIS (US Sales Only), PC A06/MF A01	DE84751266	MN -34C	9:27405
83-36-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE84751265	MN -34C	9:27408
83-37-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE84751268	MN -34	9:27257
HEDL-				
7432	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010402	MN -20c	9:26316
HEDL-SA-				
2957-FP	NTIS, PC A02; 3 (GPO Dep.)	DE84011117	MN -79	9:25993
3005-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010397	MN -25	9:26317
3020-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004828	MN -79m	9:25984
3050	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008498	MN -79	9:26022
HW-				
54341	NTIS, PC A03; 3 (GPO Dep.)	DE84010815	MN -25	9:26318
IAE-				
3526/ 7	NTIS (US Sales Only), PC A02/MF A01	DE84701403	MN -20	9:27532
3562/ 11	NTIS (US Sales Only), PC A02/MF A01	DE84701399	MN -34A	9:26439
3583/ 10	NTIS (US Sales Only), PC A02/MF A01	DE84701412	MN -34A	9:26644
IAEA-INIS-				
11-Rev.12	UNIPUB, PO Box 433, Murray Hill Station, New York, NY 10157		ND -13	9:27652
17-Rev.2	UNIPUB, PO Box 433, Murray Hill Station, New York, NY 10157		ND -13	9:27653
IC-				
82/ 159	NTIS (US Sales Only), PC A03/MF A01	DE84700917	MN -25	9:26319
82/ 163	NTIS (US Sales Only), PC A02/MF A01	DE84700900	MN -34C	9:27386
82/ 170	NTIS (US Sales Only), PC A02/MF A01	DE84700912	MN -25	9:26320
82/ 181	NTIS (US Sales Only), PC A04/MF A01	DE84700896	MN -34D	9:27313
82/ 229	NTIS (US Sales Only), PC A02/MF A01	DE84700897	MN -34D	9:27314
83/ 2	NTIS (US Sales Only), PC A02/MF A01	DE84700918	MN -25	9:26321
83/ 15	NTIS (US Sales Only), PC A02/MF A01	DE84700902	MN -34C	9:27387
83/ 26	NTIS (US Sales Only), PC A03/MF A01	DE84700901	MN -34C	9:27409
83/ 33	NTIS (US Sales Only), PC A02/MF A01	DE84700898	MN -34D	9:27315
83/ 53	NTIS (US Sales Only), PC A02/MF A01	DE84700903	MN -34C	9:27285
83/ 71	NTIS (US Sales Only), PC A02/MF A01	DE84700913	MN -25	9:26322

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83/ 74	NTIS (US Sales Only), PC A02/MF A01	DE84700914	MN -25	9:26323
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83/ 82	NTIS (US Sales Only), PC A02/MF A01	DE84700916	MN -25	9:26325
IDO-				
1523-4	*See* DOE/ID/01523-4	DE84010394	MN -66d	9:25849
IEA/EAS-				
E3/ 81/ 3	NTIS (US Sales Only), PC A06/MF A01	DE84901031	STD -90c	9:25633
IFSM-				
83-121	*See* AD-A-137388/5			9:26272
IFVE-FTOPK-				
82-132	NTIS (US Sales Only), PC A02/MF A01	DE84700944	MN -28	9:26802
IFVE-OEIPK-				
83-73	NTIS (US Sales Only), PC A02/MF A01	DE84701450	MN -34D	9:27286
IFVE-OTF-				
82-95	NTIS (US Sales Only), PC A02/MF A01	DE84701364	MN -34D	9:27358
83-75	NTIS (US Sales Only), PC A02/MF A01	DE84701419	MN -34D	9:27316
83-90	NTIS (US Sales Only), PC A02/MF A01	DE84701420	MN -34D	9:27317
IFVE-OUNK-				
82-159	NTIS (US Sales Only), PC A02/MF A01	DE84701413	MN -34A	9:26645
INDC(GER)-				
24-L(Special)	*See* NEANDC(E)-232-U(Vol.5)	DE84700906	MN -34C	9:27383
INIS-mf-				
8704	NTIS (US Sales Only), PC A04/MF A01	DE84700886	MN -34B	9:27244
IS-				
4836	NTIS, PC A08/MF A01; 1	DE83016795	MN -13	9:26683
ISH-				
16	Bundesgesundheitsamt, Neuherberg (Germany, F.R.)			9:27129
22	Bundesgesundheitsamt, Neuherberg (Germany, F.R.)			9:27033
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0170-1339	*See* N-8411349			9:26651
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52(1983)	NTIS (US Sales Only), PC A02/MF A01	DE84701365	MN -34D	9:27359
69(1983)	NTIS (US Sales Only), PC A03/MF A01	DE84701366	MN -34D	9:27360
108(1982)	NTIS (US Sales Only), PC A02/MF A01	DE84701440	MN -34D	9:27287
121(1983)	NTIS (US Sales Only), PC A02/MF A01	DE84701421	MN -34D	9:27318
ITEP-				
93(1982)	NTIS (US Sales Only), PC A03/MF A01	DE84701392	MN -34D	9:27447
ITP-				
82-122-E	NTIS (US Sales Only), PC A02/MF A01	DE84701422	MN -34D	9:27319
82-143-E	NTIS (US Sales Only), PC A02/MF A01	DE84701423	MN -34D	9:27320
83-46-E	NTIS (US Sales Only), PC A03/MF A01	DE84701424	MN -34D	9:27321
JHU/APL-OQR-				
81-4	NTIS, PC A03/MF A01 (GPO Dep.)	DE84005600	MN -64	9:25745
JINR-				
1-83-73	NTIS (US Sales Only), PC A02/MF A01	DE84701451	MN -34D	9:27288
E-1-82-387	NTIS (US Sales Only), PC A02/MF A01	DE84701441	MN -34D	9:27290
E-1-82-607	NTIS (US Sales Only), PC A02/MF A01	DE84701442	MN -34D	9:27291
E-1-82-759	NTIS (US Sales Only), PC A02/MF A01	DE84701443	MN -34D	9:27292
E-1-82-802	NTIS (US Sales Only), PC A02/MF A01	DE84701444	MN -34D	9:27293
E-2-82-651	NTIS (US Sales Only), PC A02/MF A01	DE84701445	MN -34D	9:27322
E-2-82-725	NTIS (US Sales Only), PC A02/MF A01	DE84701425	MN -34D	9:27323
E-2-82-730	NTIS (US Sales Only), PC A02/MF A01	DE84701446	MN -34D	9:27324
E-2-83-1	NTIS (US Sales Only), PC A02/MF A01	DE84701368	MN -34D	9:27325
E-2-83-28	NTIS (US Sales Only), PC A02/MF A01	DE84701374	MN -34D	9:27361
E-2-83-44	NTIS (US Sales Only), PC A02/MF A01	DE84701379	MN -34D	9:27362
E-2-83-49	NTIS (US Sales Only), PC A02/MF A01	DE84701380	MN -34D	9:27363
E-2-83-104	NTIS (US Sales Only), PC A02/MF A01	DE84701369	MN -34D	9:27364
E-2-83-150	NTIS (US Sales Only), PC A02/MF A01	DE84701370	MN -34D	9:27365
E-2-83-213	NTIS (US Sales Only), PC A02/MF A01	DE84701371	MN -34D	9:27366
E-2-83-253	NTIS (US Sales Only), PC A02/MF A01	DE84701372	MN -34D	9:27367
E-2-83-264	NTIS (US Sales Only), PC A02/MF A01	DE84701373	MN -34D	9:27368
E-2-83-283	NTIS (US Sales Only), PC A02/MF A01	DE84701375	MN -34D	9:27369
E-2-83-286	NTIS (US Sales Only), PC A02/MF A01	DE84701376	MN -34D	9:27370
E-2-83-323	NTIS (US Sales Only), PC A02/MF A01	DE84701377	MN -34D	9:27371
E-2-83-384	NTIS (US Sales Only), PC A02/MF A01	DE84701378	MN -34D	9:27448
E-3-82-849	NTIS (US Sales Only), PC A02/MF A01	DE84701454	MN -46	9:27428
E-4-83-50	NTIS (US Sales Only), PC A02/MF A01	DE84701381	MN -34D	9:27449
E-17-83-293	NTIS (US Sales Only), PC A02/MF A01	DE84701367	MN -34D	9:27440
R-1-82-908	NTIS (US Sales Only), PC A02/MF A01	DE84701447	MN -34D	9:27326
R-1-83-252	NTIS (US Sales Only), PC A02/MF A01	DE84701437	MN -34D	9:27294
R-1-83-294	NTIS (US Sales Only), PC A02/MF A01	DE84701400	MN -34A	9:27429
R-1-83-423	NTIS (US Sales Only), PC A02/MF A01	DE84701448	MN -34D	9:27295
R-2-82-647	NTIS (US Sales Only), PC A02/MF A01	DE84701383	MN -34D	9:27372
R-2-82-910	NTIS (US Sales Only), PC A02/MF A01	DE84701384	MN -34D	9:27450
R-2-83-100	NTIS (US Sales Only), PC A02/MF A01	DE84701426	MN -34D	9:27327
R-2-83-169	NTIS (US Sales Only), PC A02/MF A01	DE84701385	MN -34D	9:27328
R-2-83-266	NTIS (US Sales Only), PC A02/MF A01	DE84701386	MN -34D	9:27373
R-2-83-340	NTIS (US Sales Only), PC A02/MF A01	DE84701387	MN -34D	9:27451
R-2-83-352	NTIS (US Sales Only), PC A02/MF A01	DE84701388	MN -34D	9:27452
R-2-83-400	NTIS (US Sales Only), PC A02/MF A01	DE84701438	MN -34D	9:27329
R-4-83-222	NTIS (US Sales Only), PC A02/MF A01	DE84701389	MN -34D	9:27453
R-4-83-356	NTIS (US Sales Only), PC A02/MF A01	DE84701390	MN -34D	9:27454
R-4-83-429	NTIS (US Sales Only), PC A02/MF A01	DE84701427	MN -34D	9:27330
R-8-82-218	NTIS (US Sales Only), PC A02/MF A01	DE84701415	MN -34A	9:26646
R-13-83-20	NTIS (US Sales Only), PC A02/MF A01	DE84701414	MN -34A	9:26647

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R-14-83-102	NTIS (US Sales Only), PC A02/MF A01	DE84701455	MN -46	9:27430
R-17-83-88	NTIS (US Sales Only), PC A02/MF A01	DE84701393	MN -34D	9:27378
R-17-83-171	NTIS (US Sales Only), PC A02/MF A01	DE84701382	MN -34D	9:27374
R-17-83-291	NTIS (US Sales Only), PC A02/MF A01	DE84701401	MN -34A	9:27431
JPL-PUB-				
83-68	*See* DOE/JPL-1060-62	DE84009157	STD -62b	9:25713
83-92	*See* DOE/JPL-1060-64	DE84008507	STD -62	9:25793
84-1	*See* DOE/JPL-1060-67	DE84008501	STD -62	9:25714
Juel-				
1862	NTIS (US Sales Only), PC A06/MF A01	DE84751264	MN -20	9:27467
1869	NTIS (US Sales Only), PC A05/MF A01	DE84751261	MN -34	9:27468
Juel-Conf-				
36	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)			9:26444
Juel-Spez-				
195	NTIS (US Sales Only), PC A08 MF/A01; 1	DE84750944	MN -60	9:25858
207	NTIS (US Sales Only), PC A05/MF A01	DE84751263	MN -86	9:25397
222	Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)			9:26023
K-				
2043	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010666	STD -4	9:26468
K/CSD/TM-				
55	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009394	MN -46	9:25554
K/PS-				
5017	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010901	MN -4	9:26469
KPTI-				
82-40	NTIS (US Sales Only), PC A02/MF A01	DE84701402	MN -34A	9:27432
82-45	NTIS (US Sales Only), PC A02/MF A01	DE84701428	MN -34D	9:27337
83-2	NTIS (US Sales Only), PC A02/MF A01	DE84701432	MN -34D	9:27338
83-3	NTIS (US Sales Only), PC A02/MF A01	DE84701434	MN -34D	9:27353
83-4	NTIS (US Sales Only), PC A02/MF A01	DE84701435	MN -34D	9:27339
83-8	NTIS (US Sales Only), PC A02/MF A01	DE84701405	MN -20	9:27535
83-10	NTIS (US Sales Only), PC A02/MF A01	DE84701429	MN -34D	9:27340
83-11	NTIS (US Sales Only), PC A02/MF A01	DE84701436	MN -34D	9:27341
83-12	NTIS (US Sales Only), PC A02/MF A01	DE84701430	MN -34D	9:27342
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1445	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009485	MN -21	9:27536
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9462-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011016	STD -41	9:27166
9648-MS	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84010996	STD -34B	9:27249
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9931	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011013	STD -34	9:26803
9936-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011001	STD -15	9:25579
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10019-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011002	STD -4	9:26573
10024-MS	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011010	STD -90c	9:25223
10025	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010998	STD -11	9:26975
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80-3506	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010034	MN -38	9:26667
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84-1127	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010004	MN -34	9:27478
84-1139	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011335	MN -94b	9:26069
84-1190	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011371	MN -34	9:26668
84-1191	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011348	MN -28	9:26782
84-1217	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011332	MN -28	9:26783
84-1231	NTIS, PC A02; 3 (GPO Dep.)	DE84011331	MN -13	9:27088
84-1232	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011330	MN -28	9:26806
84-1235	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011354	MN -4	9:27260
84-1238	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011384	MN -33	9:25947
84-1279	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011327	MN -28	9:26784
84-1280	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011326	MN -28	9:26785
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84-1349	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011416	MN -28	9:26788
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13500	NTIS, PC A15/MF A01; 1	DE83004093	STD -13	9:25603
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16528	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008242	MN -20c	9:27547
16645	NTIS, PC A02/MF A01 (GPO Dep.)	DE84004239	MN -95d	9:26210
16983	NTIS, PC A04/MF A01 (GPO Dep.)	DE84010707	MN -4	9:26268
17255	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008497	MN -21	9:26774
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17477	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009245	MN -92b	9:25327
17521	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010781	MN -11	9:27237
17561	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010804	MN -28	9:26790
17575	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010716	MN -34C	9:27399
17673	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010720	MN -34D	9:27298
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8312	NTIS (US Sales Only), PC A02/MF A01	DE84700905	MN -34C	9:27299
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7035/ 1-12(1983)	*See* LUIP-8312	DE84700905	MN -34C	9:27299
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3139(OP)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84009863	MN -34C	9:27441
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3142	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010669	STD -38	9:26650
3144	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011014	STD -70	9:25507
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109	Also published in Nucl. Instrum. Methods Phys. Res. (15 Jun 1983) v. 211(213) p. 315-322			9:26827
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7814	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011229	MN -89	9:25224
7815	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011230	MN -89	9:25225
7921-Summ.	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008892	MN -21	9:27549
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73-31614	NTIS, PC A03; 3		MN -80	9:25979
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8411349	NTIS, PC A04/MF A01			9:26651
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8411447	NTIS, PC A04/MF A01			9:26679
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92-Suppl.4	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010868	MN -34A	9:27261
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82-2505	*See* PB-83-217562		MN -32	9:27635
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84-2821	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010696	MN -4	9:25328
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5-10T-2-84	Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831		STD -79	9:25939
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0554	NTIS (US Sales Only), PC A02/MF A01	DE84701406	MN -20	9:27550
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83-3	NTIS (US Sales Only), PC A06/MF A01	DE84700936	MN -41	9:26032
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2-69-2107	NTIS, PC A15/MF A01; 1	DE84901098	MN -59	9:25797
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2-70-3201	NTIS, PC A05/MF A01; 1 - NMERDI	DE84901033	MN -92a	9:25301
2-71-4136	NMERDI, Information Center-University of New Mexico, Suite M, 457 Washington, SE, Albuquerque, NM 87108		MN -58b	9:26114
2-71-4519	NMERDI, 457 Washington, SE, Suite M, Albuquerque, NM 87108		MN -58c	9:25780
2-71-4603	NMERDI Information Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108		MN -59c	9:25781
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4770230	NTIS (US Sales Only), PC A02/MF A01; 1	DE84770230	MN -98B	9:25319
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4900812	SRCC, 1001 Conn. Ave., NW Suite 800, Washington, DC 20036		ND -59	9:25653
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4900936	NTIS, PC A05/MF A01	DE84900936	MN -98C	9:25336
4900949	OCS, Office of Offshore Information Services, 12203 Sunrise Valley Drive, Reston, VA 22091		MN -92	9:25320
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4901056	Public Service Co. of New Mexico, Alvarado Square, Albuquerque, NM 87158		MN -98D	9:26137
4901139	NTIS, PC A07/MF A01; 1	DE84901139	MN -91	9:25380
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5204	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010847	MN -21	9:27551
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83-5	NTIS, PC A06/MF A01 - GPO* $5.00	DE84901150	MN -2	9:27628
NUREG-				
0040-Vol.8-No.1	NTIS, PC A14/MF A01 - GPO*	DE84901206	MN -80	9:25950
0090-Vol.6-No.3	NTIS, PC A04/MF A01; 1 - GPO*	DE84901210	MN -80	9:26033
0519-Suppl.8	NTIS, PC A02/MF A01 - GPO* - $3.50	DE84920214	MN -78	9:26034
0732-Rev.1	NTIS, PC A04/MF A01 - GPO* $4.25	DE84901131	MN -78	9:26035
0750-Vol.18-Index-1	NTIS, PC A05/MF A01 - GPO*	DE84901015	MN -2	9:25951
0750-Vol.18-No.6	NTIS, PC A09/MF A01; 1 - GPO*	DE84901135	MN -2	9:25952
0830-Suppl.3	NTIS, PC A09/MF A01; 1 - GPO* $6.00	DE84901125	MN -78	9:26036
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0940-Vol.3-No.1	NTIS, PC A15/MF A01; 1 - GPO*	DE84901101	MN -2	9:25954
1042	NTIS, PC A21/MF A01; 1 - GPO* $9.50	DE84900970	MN -78	9:25890
NUREG/BR-				
0025-Vol.10-No.2	NTIS, PC A02/MF A01 - GPO*	DE84900736	MN -2	9:26134
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2552	NTIS, PC A05; 3 - GPO (GPO Dep.)	DE84010557	MN -80	9:26037
2614	NTIS, PC A08/MF A01; 1 - GPO* $6.00	DE84900939	MN -70	9:25508
2921	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	DE84011133	MN -80	9:26038
3023	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84011675	MN -80	9:26039
3071	NTIS (US Sales Only), PC A09/MF A01; 1 - GPO $6.00 (GPO Dep.)	DE84009655	MN -78	9:25891
3200-Vol.3	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	DE84008009	MN -78	9:25913
3218	NTIS, PC A22/MF A01; 1 - GPO* $19.00	DE84901152	MN -70	9:25509
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3303	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84010431	MN -78	9:25985
3307-Vol.3	NTIS, PC A04/MF A01 - GPO $4.50 (GPO Dep.)	DE84011212	MN -78	9:26040
3334-Vol.3	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	DE84007577	MN -78	9:25971
3350	NTIS, PC A04/MF A01 - GPO $4.50 (GPO Dep.)	DE84010898	MN -78	9:26041
3379	NTIS, PC A05/MF A01 - GPO (GPO Dep.)	DE84011132	MN -79a	9:26042
3427-Vol.3	NTIS, PC A05/MF A01; 1 - GPO* $4.75	DE84900968	MN -70	9:25510
3511-Vol.1	NTIS, PC A12/MF A01 - GPO (GPO Dep.)	DE84011259	MN -78	9:26043
3526	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	DE84006514	MN -80	9:26044
3533	NTIS, PC A05/MF A01; 1 - GPO $4.50 (GPO Dep.)	DE84011549	MN -70A	9:25511
3539	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	DE84010319	MN -78	9:26045
3564	NTIS, PC A05/MF A01; 1 - GPO $4.50 (GPO Dep.)	DE84010654	MN -78	9:26046
3581	NTIS, PC A06/MF A01; 1 - GPO $4.75 (GPO Dep.)	DE84011714	MN -80	9:25914
3596	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84010548	MN -78	9:26047
3625	NTIS, PC A06/MF A01; 1 - GPO $5.00 (GPO Dep.)	DE84009337	MN -78	9:25972
3633-Vol.1	NTIS, PC A11/MF A01; 1 - GPO (GPO Dep.)	DE84011148	MN -78	9:26048
3633-Vol.2	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84010544	MN -78	9:26049
3637	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84008979	MN -80	9:25881
3644	NTIS, PC A03/MF A01; 1 - GPO $3.75 (GPO Dep.)	DE84011211	MN -79	9:26050
3650	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	DE84008854	MN -80	9:26051
3652	NTIS, PC A03/MF A01 - GPO (GPO Dep.)	DE84010429	MN -78	9:26052
3661	NTIS, PC A09/MF A01; 1 - GPO* $6.00	DE84900679	MN -78	9:26053
3677	NTIS, PC A02/MF A01; 1 - GPO $3.25 (GPO Dep.)	DE84010937	MN -70	9:27167
3680	NTIS, PC A07/MF A01; 1 - GPO* $5.50	DE84901181	MN -38	9:25335
3687	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	DE84010563	MN -80	9:25973
3697	NTIS, PC A03/MF A01 - GPO $4.25 (GPO Dep.)	DE84011210	MN -11	9:25512
3717	NTIS, PC A06/MF A01; 1 - GPO* $4.75	DE84900990	MN -41	9:25892
3718	NTIS, PC A03/MF A01; 1 - GPO $3.75 (GPO Dep.)	DE84010562	MN -80	9:25893
3727	NTIS (US Sales Only), PC A03/MF A01; 1 - GPO $4.00 (GPO Dep.)	DE84011718	MN -78	9:26054
3740	NTIS, PC A06/MF A01; 1 - GPO* $4.75	DE84900940	MN -80	9:26333
3756	NTIS, PC A23/MF A01; 1 - GPO $10.00 (GPO Dep.)	DE84011311	MN -11	9:25990
3758	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	DE84011310	MN -70	9:25513
3768	NTIS, PC A09/MF A01; 1 - GPO*	DE84901151	MN -11	9:27233
3769	NTIS, PC A03/MF A01; 1 - GPO* $4.00	DE84901184	MN -11	9:27234
3774-Vol.1	NTIS, PC A05/MF A01; 1 - GPO* $4.50	DE84901100	MN -70B	9:25514
NYSERDA-				
84-2	New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223		MN -95a	9:26211
NZERDC-P-				
80	NTIS (US Sales Only), PC A03/MF A01	DE84900969	MN -96	9:26254
OCS-				
4900947	OCS Information Program, Office of Offshore Information Services, 12203 Sunrise Valley Dr., Reston, VA 22091		MN -92	9:25322
ORNL-				
6033	NTIS, PC A04/MF A01 (GPO Dep.)	DE84010665	STD -97	9:26912
6039	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012044	STD -4	9:26472
ORNL/Sub-				
81-7685/ 2and92	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012042	MN -95d	9:26212
82/ 13810/ 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010943	MN -70B	9:25515
7698/ 1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84011151	MN -11	9:26251
ORNL/TM-				
7378	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010629	STD -59b	9:25590
8551	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010964	MN -41	9:25226
8633	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010616	STD -71	9:26653

Report No.	Availability	Order No.	Distribution Category	Abstract No.
8729	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011818	MN -78	9:25915
8774	*See* NUREG/CR-3303	DE84010431	MN -78	9:25985
8787-Vol.3	*See* NUREG/CR-3334-Vol.3	DE84007577	MN -78	9:25971
8796/ V3	*See* NUREG/CR-3200-Vol.3	DE84008009	MN -78	9:25913
8951	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011856	MN -90i	9:25258
8964	*See* NUREG/CR-3539	DE84010319	MN -78	9:26045
9002	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007555	STD -20	9:27552
9029	*See* NUREG/CR-3652	DE84010429	MN -78	9:26052
9042	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010640	MN -90	9:26408
9107	*See* NUREG/CR-3687	DE84010563	MN -80	9:25973
9138	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010667	STD -41	9:27168
9156	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011824	STD -70B	9:25516
9167	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012025	STD -4	9:26473
OSS/TM-				
1	NTIS (US Sales Only), PC A03/MF A01	DE84700933	MN -41	9:25529
2	NTIS (US Sales Only), PC A02/MF A01	DE84700934	MN -41	9:25530
3	NTIS (US Sales Only), PC A02/MF A01	DE84700935	MN -41	9:25531
P-				
103-83-001	CEC, 1516 9th Street, Sacramento, CA 95814		MN -58a	9:26166
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)			
A 6-443,988		DE84005938	MN -38	9:26738
A 6-473,180		DE84006153	MN -37	9:26659
A 6-477,458		DE84010888	MN -28	9:26796
A 6-491,132		DE84010887	MN -48	9:27152
A 6-491,133		DE84010962	MN -92a	9:25310
A 6-491,639		DE84010960	MN -20a	9:27620
A 6-492,924		DE84010959	MN -20	9:27619
A 6-492,926		DE84010984	MN -4	9:26490
A 6-494,236		DE84010985	MN -91	9:25378
A 6-494,484		DE84011080	MN -25	9:26423
A 6-494,487		DE84011082	MN -37	9:26764
A 6-495,205		DE84011089	MN -90a	9:25248
A 6-495,386		DE84011090	MN -20	9:27503
A 6-495,888		DE84011091	MN -4	9:26489
A 6-498,437		DE84011085	MN -4	9:25642
A 6-498,438		DE84011086	MN -90c	9:25235
A 6-498,999		DE84011087	MN -63	9:25697
A 6-500,101		DE84011088	MN -61D	9:25627
A 6-500,102		DE84011081	MN -25	9:26373
A 6-500,105		DE84011070	MN -20	9:27617
A 6-500,106		DE84011074	MN -37	9:26899
A 6-500,107		DE84011075	MN -83	9:25584
A 6-500,199		DE84011077	MN -20	9:27618
A 6-500,717		DE84011078	MN -37	9:26898
A 6-501,313		DE84011094	MN -37	9:26897
A 6-503,128		DE84011095	MN -25	9:26169
A 6-503,129		DE84011096	MN -78	9:25997
A 6-503,130		DE84011097	MN -37	9:25583
A 6-503,373		DE84011098	MN -38	9:26755
A 6-504,904		DE84011099	MN -10	9:25393
A 6-504,905		DE84011100	MN -38	9:26896
A 6-506,559		DE84011107	MN -25	9:26416
A 6-506,560		DE84011102	MN -4	9:25641
A 6-507,188		DE84011103	MN -92	9:25341
A 6-507,189		DE84011104	MN -38	9:26660
A 6-509,077		DE84011106	MN -48	9:26564
A 6-509,555		DE84011109	MN -37	9:26895
A 6-509,557		DE84011110	MN -91	9:25377
A 6-509,758		DE84011111	MN -37	9:26894
A 6-511,702		DE84011112	MN -20	9:27616
A 6-513,521		DE84011114	MN -37	9:26674
A 6-514,126		DE84011118	MN -16	9:25582
A 6-514,127		DE84011119	MN -97	9:25875
A 6-515,844		DE84011120	MN -25	9:26524
A 6-517,138		DE84011121	MN -92a	9:25309
A 6-517,473		DE84011122	MN -94c	9:26086
A 6-517,474		DE84010066	MN -25	9:26372
A 6-517,475		DE84011029	MN -70	9:25527
A 6-517,476		DE84011030	MN -20	9:27615
A 6-517,536		DE84011034	MN -25	9:26415
A 6-519,873		DE84011036	MN -25	9:26369
A 6-519,941		DE84011037	MN -25	9:26370
A 6-521,497		DE84011038	MN -63	9:25696
A 6-521,815		DE84011039	MN -79a	9:25945
A 6-521,816		DE84011040	MN -48	9:26563
A 6-522,277		DE84011041	MN -90i	9:25233
A 6-522,282		DE84011042	MN -37	9:26893
A 6-523,207		DE84011043	MN -79p	9:25988
A 6-523,492		DE84011044	MN -95e	9:26237
A 6-523,556		DE84011045	MN -25	9:26414
A 6-526,246		DE84011232	MN -48	9:27184
A 6-526,249		DE84011231	MN -4	9:25392
A 6-526,251		DE84011272	MN -48	9:27151

Report No.	Availability	Order No.	Distribution Category	Abstract No.
A 6-526,855		DE84011309	MN -90c	9:25232
A 6-527,547		DE84011304	MN -80	9:25980
A 6-528,279		DE84011306	MN -86	9:25400
A 6-528,284		DE84010873	MN -48	9:27111
A 6-528,285		DE84010874	MN -21	9:27614
A 6-528,509		DE84011301	MN -37	9:26672
A 6-528,510		DE84011302	MN -4	9:26483
A 6-534,427		DE84011299	MN -91	9:25375
A 6-534,472		DE84011289	MN -91	9:25376
A 6-535,462		DE84011290	MN -80	9:25944
A 6-535,463		DE84011285	MN -90d	9:25640
A 6-535,464		DE84011286	MN -21	9:27611
A 6-535,974		DE84011287	MN -20	9:27612
A 6-537,218		DE84011284	MN -21	9:27610
A 6-537,219		DE84011297	MN -25	9:26539
A 6-538,006		DE84011282	MN -90b	9:25277
A 6-538,059		DE84010872	MN -37	9:26892
A 6-538,889		DE84011283	MN -25	9:26270
A 6-538,890		DE84011298	MN -25	9:26271
A 6-539,011		DE84011281	MN -37	9:26754
A 6-539,013		DE84011296	MN -37	9:26891
A 6-539,366		DE84011279	MN -4	9:26537
A 6-539,367		DE84011294	MN -25	9:26875
A 6-539,369		DE84011295	MN -37	9:26890
A 6-539,370		DE84011292	MN -80	9:25987
A 6-539,493		DE84011291	MN -25	9:26538
PB-				
83-217562	NTIS, PC A04; 3		MN -32	9:27635
83-221093	NTIS, PC A08/MF A01		MN -64	9:25746
83-221143	NTIS, PC A05/MF A01		MN -64	9:25747
83-221176	NTIS, PC A06/MF A01; 1		MN -64	9:25748
83-221184	NTIS, PC A04/MF A01		MN -64	9:25749
83-221309	NTIS, PC A09/MF A01		MN -64	9:25750
83-221374	NTIS, PC A08; 3		MN -64	9:25751
83-221853	NTIS, PC A19/MF A01		MN -64	9:25752
83-221945	NTIS, PC A05; 3		MN -64	9:25753
83-222059	NTIS, PC A15; 3		MN -64	9:25754
83-222109	NTIS, PC A08/MF A01		MN -64	9:25755
83-232074	*See* N-8410331			9:26991
84-114354	NTIS, PC A12/MF A01			9:27050
84-143577	NTIS, PC A04/MF A01			9:26260
84-143817	NTIS PC E04/MF E04			9:26213
84-144088	NTIS, PC A02/MF A01			9:26221
84-144674	NTIS PC E04/MF E04			9:26258
84-145937	NTIS, PC A05/MF A01			9:26222
84-146166	NTIS, PC A04			9:26261
84-148014	NTIS, PC A04/MF A01			9:26262
84-148543	NTIS, PC A03/MF A01			9:26255
84-149590	NTIS, PC A08/MF A01			9:27155
84-149632	NTIS, PC A04/MF A01			9:26992
84-151091	NTIS, PC A05/MF A01			9:26214
84-151174	NTIS, PC A03/MF A01			9:26223
84-151182	NTIS, PC A06/MF A01			9:26224
84-151299	NTIS, PC A02/MF A01			9:27058
84-151992	NTIS, PC A05/MF A01			9:25782
84-152016	NTIS, PC A02/MF A01			9:26474
84-152172	NTIS, PC A02/MF A01			9:27059
84-153469	NTIS PC $30.00			9:26225
84-161843	NTIS, PC A15/MF A01			9:26055
264232	NTIS, PC A02/MF A01	DE84900921	MN -11	9:26993
PFC/RR-				
84-5	*See* DOE/ET/51013-120	DE84010577	STD -20g	9:27463
PNL-				
4543	*See* NUREG/CR-3071	DE84009655	MN -78	9:25891
4545	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010924	MN -11	9:27035
4614-Vol.2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010763	MN -11	9:27203
4693	*See* NUREG/CR-3581	DE84011714	MN -80	9:25914
4705-3	*See* NUREG/CR-3307-Vol.3	DE84011212	MN -78	9:26040
4709	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84011127	MN -11	9:26124
4878	*See* NUREG/CR-3533	DE84011549	MN -70A	9:25511
4909	*See* NUREG/CR-3564	DE84010654	MN -78	9:26046
4933	*See* NUREG/CR-3350	DE84010898	MN -78	9:26041
4957	*See* NUREG/CR-3625	DE84009337	MN -78	9:25972
4982	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010760	MN -90d	9:25227
5013	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011401	MN -25	9:26334
5016	*See* NUREG/CR-3677	DE84010937	MN -70	9:27167
5025	*See* NUREG/CR-3697	DE84011210	MN -11	9:25512
5043	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010651	MN -37	9:26654
5050	*See* NUREG/CR-3727	DE84011718	MN -78	9:26054
5079	NTIS, PC A03; 3 (GPO Dep.)	DE84011400	MN -41	9:27036
PNL-SA-				
11331	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010702	MN -90a	9:25245
11388	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010627	MN -70B	9:25532
11394	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010951	MN -25	9:26450
11531	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010900	MN -11	9:26994

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11573	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010776	MN -70	9:25517
11643	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011270	MN -70B	9:25533
11684	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010699	MN -70A	9:25518
11685	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008678	MN -70	9:25478
11728	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010773	MN -11	9:27060
11740	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010647	MN -4	9:25236
11751	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011169	MN -46	9:25986
11777	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011360	MN -11	9:27169
11778	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010877	MN -11	9:27170
11821	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010864	MN -11	9:25519
11842	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011269	MN -16	9:25580
11889	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008299	MN -11	9:27063
11978	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010697	MN -11	9:26125
11979	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010701	MN -11	9:26117
12022	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008662	MN -85	9:25479
12058	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008649	MN -13	9:27629
12069	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010700	MN -48	9:27120
12101	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010703	MN -41	9:27171
12119	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010778	MN -11	9:26929
12130	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010845	MN -48	9:27172
12159	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010780	MN -25	9:26335
12198	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010705	MN -41	9:25571
PPPL-				
2029	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010770	STD -20g	9:27479
2048	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006281	STD -20	9:27553
2084	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010748	STD -20	9:27480
2090	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010753	STD -20g	9:27481
2094	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010403	STD -20g	9:27554
2096	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010752	STD -20f	9:27482
2098	NTIS, PC A03; 3 (GPO Dep.)	DE84010769	STD -20g	9:27483
2104	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011199	STD -20g	9:27555
2105	NTIS, PC A04; 3 (GPO Dep.)	DE84010771	STD -20e	9:27556
RAE-				
18-5	*See* NUREG/CR-3533	DE84011549	MN -70A	9:25511
RFP-				
3619	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011325	STD -70	9:25520
RHO-SS-SA-				
10	*See* PNL-SA-11842	DE84011269	MN -16	9:25580
RL-				
82-086	NTIS (US Sales Only), PC A02/MF A01	DE84700945	MN -28	9:26808
82-087	NTIS (US Sales Only), PC A03/MF A01	DE84700946	MN -28	9:26828
83-011	NTIS (US Sales Only), PC A02/MF A01	DE84700892	MN -34D	9:27346
83-012	NTIS (US Sales Only), PC A02/MF A01	DE84700893	MN -34D	9:27354
83-015	NTIS (US Sales Only), PC A02/MF A01	DE84700894	MN -34D	9:27300
83-016	NTIS (US Sales Only), PC A02/MF A01	DE84700895	MN -34D	9:27301
83-027	NTIS (US Sales Only), PC A02/MF A01	DE84700923	MN -34B	9:27250
83-028	NTIS (US Sales Only), PC A02/MF A01	DE84700924	MN -34B	9:27251
83-029	NTIS (US Sales Only), PC A02/MF A01	DE84700925	MN -34B	9:27252
83-036	NTIS (US Sales Only), PC A03/MF A01	DE84700887	MN -34B	9:27246
83-038	NTIS (US Sales Only), PC A02/MF A01	DE84700883	MN -20	9:27484
83-049	NTIS (US Sales Only), PC A02/MF A01	DE84700947	MN -28	9:26776
SAI-				
84-3033/ PRI-77	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010842	STD -20g	9:27487
464-810-007-LA	*See* PB-83-221176		MN -64	9:25748
464-820-011-LA	*See* PB-83-221945		MN -64	9:25753
SAND-				
81-8192/ 1	NTIS, PC A07; 3 (GPO Dep.)	DE84009610	MN -62d	9:25722
81-8192/ 3	NTIS, PC A12; 3 (GPO Dep.)	DE84009207	MN -62d	9:25723
82-0342	*See* NUREG/CR-2552	DE84010557	MN -80	9:26037
82-1145	*See* NUREG/CR-2921	DE84011133	MN -80	9:26038
82-2475	*See* NUREG/CR-3023	DE84011675	MN -80	9:26039
83-1248C	NTIS, PC A02; 3 (GPO Dep.)	DE84003763	MN -21	9:27559
83-1522C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010536	MN -34	9:27456
83-1670	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011626	MN -32	9:27636
83-1690C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010131	MN -25	9:26344
83-1766C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009067	MN -38	9:26887
83-2012C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010976	MN -25	9:26451
83-2014C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011194	MN -63b	9:25684
83-2015C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010979	MN -63	9:25705
83-2033C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010932	MN -63	9:25685
83-2086-Vol.1	*See* NUREG/CR-3511-Vol.1	DE84011259	MN -78	9:26043
83-2117C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011188	MN -63	9:25706
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TN Tunisia
TO Tonga
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TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
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VE Venezuela
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